

# **EXHIBIT 1**

# **FILED UNDER SEAL**

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**UNITED STATES DISTRICT COURT**  
**NORTHERN DISTRICT OF CALIFORNIA**  
**SAN FRANCISCO DIVISION**

GOOGLE LLC,

Plaintiff

v.

SONOS, INC.,

Defendant.

CASE NO. 3:20-cv-06754-WHA  
Related to CASE NO. 3:21-cv-07559-WHA

**OPENING EXPERT REPORT OF DR. DAN SCHONFELD REGARDING U.S. PATENT  
NO. 10,848,885 AND U.S. PATENT NO. 10,469,966**

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managing the ad hoc creation and deletion of groups.” Not so. Indeed, prior art computerized systems such as Sonos’s own system and the Logitech system allowed for “ad hoc” and “dynamic” group management through a digital interface. Sonos’s claim that there was “a need for dynamic control of the audio players as a group” and a system in which “the audio players may be readily grouped” contradicts its own admission that digital music systems and “conventional” multi-zone audio systems already existed. Sonos’s claim that a problem with “a traditional multi-zone audio system” is that “audio players have to be adjusted one at a time, resulting in an inconvenient and non-homogenous audio environment” misses the fact that Sonos has already admitted that multi-zone audio systems were conventional and that the claims say nothing about adjusting speakers one at a time or not, unless Sonos uses this to refer to grouping, which as it already admitted, was well known at the time of the invention.

**A. Sonos’s Own Systems**

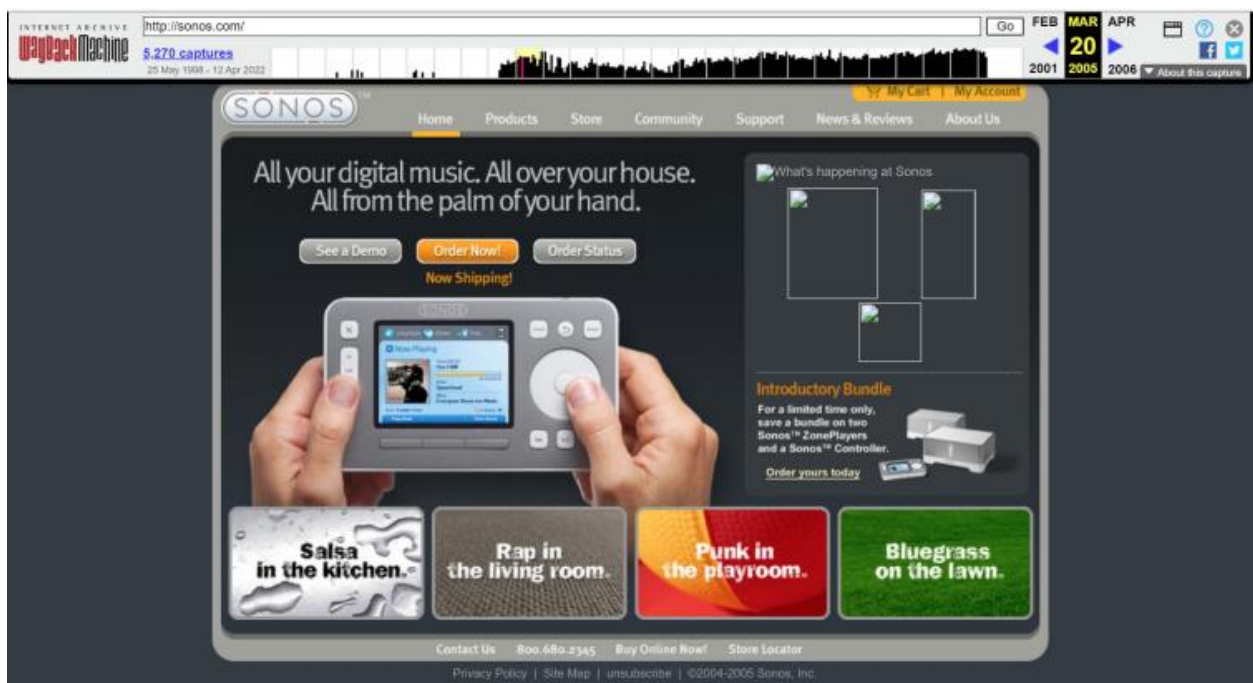
124. The Sonos System is Prior Art I define the “Sonos System” as a system of Sonos products available before September 12, 2005, and including at least one controller device (e.g. a CR100 controller, available no later than April 2005 - <https://www.cnet.com/reviews/sonos-controller-cr100-preview/>) and multiple zone players (e.g. ZP100 zone players, also available no later than April 2005, <https://www.cnet.com/reviews/sonos-zoneplayer-zp100-preview/>).

125. I understand that the Sonos System is prior art under 35 U.S.C. 102(b) because it was in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States (*i.e.*, more than one year before September 12, 2006). I understand that the Sonos System is also prior art under 35 U.S.C. 102(a) because it was known or used by others in this country and described in a printed publication in this or a foreign country before the invention thereof by the applicant for patent (*i.e.*, before Sonos’s alleged invention date of December 21, 2005). I disagree with Sonos’s alleged invention date as discussed in Section XI,

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but assuming that this invention date applies, the Sonos System remains prior art under 35 U.S.C. 102(a).

126. For example, Sonos's employees have testified that the Sonos System was available at least by 2004. Lambourne Dep. Tr. at 90:10-98:8. Sonos's webpage advertised and offered the Sonos System for sale no later than March 2005. *E.g.*, GOOG-SONOS-NDCA-00108095 ("IA") at 118-192.<sup>4</sup>



IA at 119.

127. Reviews of the Sonos System were issued no later than May 2005. IA at 193-195; 209-216; 237-239; 249-259 (October 2005). Sonos authored user manuals for the Sonos System dated no later than April 2004. Lambourne Dep. Ex. 1077 (April 2004); IA at 357-492 (January 2006). Mr. Lambourne, who worked on the Sonos System, testified that he was not aware of dates on their user manuals being inaccurate. Lambourne Dep. Tr. at 152:13-164:25. Sonos also

<sup>4</sup> References to IA refer to an Internet Archive declaration produced in this case at GOOG-SONOS-NDCA-00108095.



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publicly offered specifications sheets for its Sonos System no later than May 2005. IA at 493-494.

128. Sonos's press releases also show that Sonos sold and offered for sale the Sonos System no later than January 27, 2005.

## **AWARD-WINNING SONOS™ DIGITAL MUSIC SYSTEM BEGINS SHIPPING TO CONSUMERS**

**SANTA BARBARA, Calif. — January 27, 2005** — Sonos, Inc. today announced that the award-winning Sonos™ Digital Music System has begun shipping to pre-order customers in the United States. The Sonos Digital Music System is the first and only multi-zone digital music system with a wireless, full-color LCD screen controller that lets consumers play all their digital music, all over their home, and control it all from the palm of their hand. The company expects that all pre-orders will be filled within 10 days.

The Sonos Digital Music System is now available for purchase online at [www.sonos.com](http://www.sonos.com) and will be offered at consumer electronic retailers across the nation over the next several weeks. Sonos now offers an introductory bundle of two Sonos™ ZonePlayers and a Sonos™ Controller for \$1,199.00. Since the system is scalable up to 32 zones, additional ZonePlayers retail for \$499.00 and additional Controllers retail for \$399.00.

IA at 166.

## **REALNETWORKS and SONOS TEAM TO OFFER FIRST MULTI-ROOM DIGITAL MUSIC SERVICE**

**Rhapsody Will Be Available Via Sonos™ Digital Music System in March**

**See the Demo at CES; Sonos & RealNetworks Booths in LVCC South Hall**

**SEATTLE & SANTA BARBARA, Calif. — January 05, 2005** — Sonos, Inc., the developer of the award-winning Sonos™ Digital Music System, and RealNetworks® (Nasdaq: RNWK), the leading creator of digital media services and software, today announced a partnership to integrate and promote the leading Rhapsody® online music service with the Sonos Digital Music System. Today's news marks the first time that a legal digital music service has been made available for use in multi-room environments. With Sonos and Rhapsody, consumers will now have the flexibility to enjoy multiple Rhapsody streams in different areas of the home, and for the first time, control it all from the palm of their hand.

The Sonos Digital Music System is the first and only multi-zone digital music system with a wireless, full-color LCD screen controller that lets consumers play all their digital music, all over their home, and control it all from the palm of their hand. Sonos customers with a Rhapsody subscription will now have easy access to their personalized Rhapsody library using their Sonos™ Controller and will be able to play the Rhapsody music over multiple Sonos™ ZonePlayers throughout the home perfectly synchronized. Subscribers will be able to browse and select their favorite music, playlists and Internet radio stations and will be able to view the track information and album art.

IA at 168.

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## SONOS ANNOUNCES RETAIL DISTRIBUTION OF THE AWARD-WINNING SONOS™ DIGITAL MUSIC SYSTEM

**Crutchfield, Magnolia Audio Video and Ovation Audio Video Among First Retailers to Offer Consumers Total Control of Their Digital Music Anywhere in the Home**

SANTA BARBARA, Calif. — March 07, 2005 — Sonos, Inc. today announced that the company has signed up more than 70 retailers and custom integrators to sell the award-winning Sonos™ Digital Music System. Retailers including Crutchfield, Magnolia Audio Video, Ovation Audio Video and 6th Avenue Electronics now offer their customers the Sonos Introductory Bundle of two Sonos™ ZonePlayers and one Sonos™ Controller for \$1,199.

The Sonos Digital Music System is also available through the custom integrator channel, including New Jersey's TheaterMax, cyberManor in the San Francisco Bay Area and Chicago's Metronet Safe & Sound and can be seen in their showrooms.

"Digital music lovers can now go out and touch our product at the retail level. This is very important during the early sales cycle for a product that is developing a new category," said Tom Cullen, Vice President of Sales and Marketing, Sonos, Inc. "Once the consumer receives a demonstration of the product in-person, we believe they will see that their dream of whole-home digital music is now a reality."

The Sonos Digital Music System is the first and only multi-zone digital music system with a wireless, full-color LCD screen controller that lets consumers play all their digital music, all over their home, and control it all from the palm of their hand.

To learn more about the Sonos Digital Music System or to find a dealer, please visit [www.sonos.com](http://www.sonos.com).

IA at 164; IA at 166.

## Press Releases

### March, 2005

- [SONOS INTRODUCES THE SONOS™ LOUDSPEAKER SP100](#)
- [SONOS ANNOUNCES RETAIL DISTRIBUTION OF THE AWARD-WINNING SONOS™ DIGITAL MUSIC SYSTEM](#)

### January, 2005

- [AWARD-WINNING SONOS™ DIGITAL MUSIC SYSTEM BEGINS SHIPPING TO CONSUMERS](#)
- [REALNETWORKS and SONOS TEAM TO OFFER FIRST MULTI-ROOM DIGITAL MUSIC SERVICE](#)
- [SONOS DIGITAL MUSIC SYSTEM HONORED WITH 2005 IF PRODUCT DESIGN AWARD](#)

### November, 2004

- [SONOS™ DIGITAL MUSIC SYSTEM HONORED AS "BEST OF AUDIO" IN THE 2005 CES INNOVATIONS DESIGN & ENGINEERING AWARDS](#)
- [SONOS™ DIGITAL MUSIC SYSTEM HONORED BY POPULAR SCIENCE MAGAZINE](#)

### June, 2004

- [WHOLE HOME DIGITAL MUSIC ARRIVES WITH THE SONOS™ DIGITAL MUSIC SYSTEM](#)

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IA at 171.

## **SONOS INTRODUCES THE SONOS™ LOUDSPEAKER SP100**

**SANTA BARBARA, Calif. — March 21, 2005 —** Sonos, Inc. today announced the immediate availability of a compact, high-performance bookshelf speaker. The company is now offering the Sonos™ Loudspeaker SP100 as an optional purchase with the award-winning Sonos™ Digital Music System. The sleek and contemporary speaker is engineered to deliver great sound in a compact form factor, all while providing digital music lovers with a complete home solution.

The style of the Sonos Loudspeaker SP100 complements the cosmetic design of the Sonos Digital Music System. The speaker features a matte dark-gray cabinet finish with a removable charcoal colored grille. The SP100 includes high-quality drivers, a 1" magnetically shielded Teteron dome tweeter, and a silver 5.5" magnetically shielded polypropylene copolymer core woofer. The speakers are designed with metal spring-binding posts and come with a pair of 14-gauge speaker wires.

IA at 173.

## **SONOS ANNOUNCES RETAIL DISTRIBUTION OF THE AWARD-WINNING SONOS™ DIGITAL MUSIC SYSTEM**

**Crutchfield, Magnolia Audio Video and Ovation Audio Video Among First Retailers to Offer Consumers Total Control of Their Digital Music Anywhere in the Home**

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The Sonos Digital Music System is also available through the custom integrator channel, including New Jersey's TheaterMax, cyberManor in the San Francisco Bay Area and Chicago's Metronet Safe & Sound and can be seen in their showrooms.

IA at 175.

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## AWARD-WINNING SONOS™ DIGITAL MUSIC SYSTEM BEGINS SHIPPING TO CONSUMERS

**SANTA BARBARA, Calif. — January 27, 2005** — Sonos, Inc. today announced that the award-winning Sonos™ Digital Music System has begun shipping to pre-order customers in the United States. The Sonos Digital Music System is the first and only multi-zone digital music system with a wireless, full-color LCD screen controller that lets consumers play all their digital music, all over their home, and control it all from the palm of their hand. The company expects that all pre-orders will be filled within 10 days.

The Sonos Digital Music System is now available for purchase online at [www.sonos.com](http://www.sonos.com) and will be offered at consumer electronic retailers across the nation over the next several weeks. Sonos now offers an introductory bundle of two Sonos™ ZonePlayers and a Sonos™ Controller for \$1,199.00. Since the system is scalable up to 32 zones, additional ZonePlayers retail for \$499.00 and additional Controllers retail for \$399.00.

IA at 177.

## WHOLE HOME DIGITAL MUSIC ARRIVES WITH THE SONOS™ DIGITAL MUSIC SYSTEM

### Multi-Zone Digital Music System Renders the Traditional Black Stereo Rack Obsolete

**SANTA BARBARA, Calif. — June 07, 2004** — Digital music fans can now listen to rock in the garden, punk in the playroom and fusion in the bedroom, with the launch of the Sonos™ Digital Music System. The Sonos offering is the first and only multi-zone digital music system with a wireless, full-color LCD screen controller that lets consumers play all their digital music, all over their home, while controlling it all from the palm of their hand.

The Sonos Digital Music System is comprised of two stylish components: the Sonos™ ZonePlayer, a networked audio player that distributes, plays and amplifies music in any "zone" in the home, and the Sonos™ Controller, a wireless handheld device with a full-color screen which allows the user to access, customize and control the music anywhere- from the bedroom to the backyard.

IA at 188; *see also* IA at 194; IA at 197; IA at 202; IA at 238; IA at 249.

129. There does not appear to be any dispute that the Sonos System is prior art. *See* Almeroth Reb. Rep. e.g., ¶¶274-290.

## 2. The Sonos System Overview

130. The Sonos System allows a user to send music to various zones and to link zones together so that more than one ZonePlayer can play the same source. These abilities can be used when a user wants to jump back and forth between two particular zones, and they make the system a “whole house music management solution.” As described below, “not only can you add and assign new ZonePlayers to your Sonos Digital Music network, you can group or ‘link’ zones so



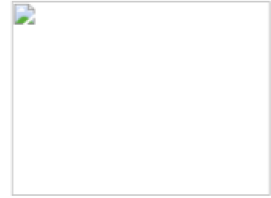
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that more than one ZonePlayer can play the same source,” which is “perfect for party modes or for when you might be jumping back and forth between two particular zones.”

**Sending Music to Various Zones**

Each Zone can either stream music from your music library, any of the ZonePlayer line inputs, or the Internet (via free online radio stations supported by Sonos or user-added MP3-streaming broadcasts). Did you catch the part about being able to select Line-inputs? Don't ignore that one. With Sonos, you can send any two-channel source into a ZonePlayer and then stream that source to *any* or *all* of your other zones. I would suggest hooking up the CD or DVD player's analogue outputs to the nearest ZonePlayer just because it allows you to quickly send a brand new disc (or perhaps one you haven't yet encoded) to another room with the push of a button.

The process for doing any of these things is so straightforward it is hardly worth noting. Use the Controller to select a zone, select your source and hit the 'Enter' button at the center of the scroll wheel.

**Linking Zones**

Not only can you add and assign new ZonePlayers to your Sonos Digital Music System network, you can group or 'Link' zones so that more than one ZonePlayer can play the same source. This is perfect for party modes or for when you might be jumping back and forth between two particular zones. This feature really takes this system up a notch as it truly makes it a whole house music *management* solution.

IA at 255.

131. The Sonos System allows a user to direct different streams of music to different rooms, link rooms together so that they all play the same music, and to adjust volume either independently or as a group through the Sonos software.

You can perform some pretty sophisticated stunts using that remote, like directing different streams of music to different rooms, linking several rooms so that they all play the same music, adjusting their volume either independently or as a group, and queuing up what music you want to hear next. The Sonos software manages to make all of this simple and visual.

IA at 271.

132. The Sonos controller software allows a user to unmute their “House” and mute their House or a Group, as well as modify the equalizer, play next, play now, play previous, add to queue, and play on “Random” and “Repeat” settings.

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## Windows Shortcut Keys

FUNCTION	KEY SEQUENCE
Help	F1
Album Art	F4
Equalizer	F5
Unmute House	F6
Mute House	F7
Mute Group	F8
Volume Down	F9
Volume Up	F10
Next	CTRL + F
Play/Pause	CTRL + P
Play Now	CTRL + N
Previous	CTRL + B
Add to Queue	CTRL + Q
Random	CTRL + H
Repeat	CTRL + T

IA at 368; Lambourne Dep. Ex. 1077 at 25, 26, 60.

133. Sonos describes the setup of the Sonos System as follows:

### 1-2-3 Setup

It takes just 3 steps to get your Sonos Digital Music System up and running:

- 1 Connect speakers to your ZonePlayer
- 2 Connect the first Sonos ZonePlayer (with Ethernet cable supplied) to your home network
- 3 Install the computer software (or use a Controller) to configure your music system

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IA at 369; Lambourne Dep. Ex. 1077 at 11.

134. A Sonos user could, as setup item #1 suggests, connect their speakers to the ZonePlayer as follows:

### 1 Step 1: Set Up Speakers/Apply Power

Your speaker's power rating should be at least 75W for 8 Ohm speakers, and at least 150W for 4 Ohm speakers. **Do not connect speakers rated at less than 4 Ohms.**

**Note:** Connect the **red (+)** and **black (-)** terminals from each speaker to the corresponding terminals on the ZonePlayer. Mismatching of polarities will result in weak central sound, and a distorted sense of sound direction.

1. When making connections, ensure that none of the strands of your speaker wire come in contact with an adjoining terminal on the rear panel.



2. Use your thumb or finger to firmly push the spring-loaded speaker connector post inward to reveal the connection hole.
3. Insert the stripped end of the speaker wire into the hole, then release. The stripped portion should be caught firmly in the connector post.
4. Repeat to install the other speaker wires.
5. Attach the power cord to the ZonePlayer and plug into a wall outlet.

The **Mute** button indicator and the **ZonePlayer Status** indicator will begin to flash. (If this ZonePlayer was previously connected to another Sonos Digital Music System, the ZonePlayer Status indicator may light solid white instead.)

Lambourne Dep. Ex. 1077 at 14.

135. The ZonePlayer must then be hardwired into an Ethernet router:

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## 2 Step 2: Connect First ZonePlayer

1. Connect the Ethernet cable from an open port on your router to any of the four (4) Ethernet switch connectors on the back of your ZonePlayer (see **A** in the diagram below).
  - If your modem is currently plugged into the only network interface connector on your computer, you should install a standard router before continuing. If you don't have a router, go to <http://faq.sonos.com/norouter> for instructions.

Or,

- If you have structured (built-in) wiring that connects to a router located elsewhere in your home, you can connect the Ethernet cable from a live wall plate into one of the four Ethernet switch connectors on the back of your ZonePlayer (see **B** in the diagram below).

IA at 370, 371; Lambourne Dep. Ex. 1077 at 15.

136. Next, the user must install the software to operate the Sonos System.

## 3 Step 3: Install software

If your operating system is Macintosh® OS X (version 10.3 or later), Windows® 2000 or Windows® XP, insert the Sonos System Setup CD-ROM and follow the on-screen instructions to install the software which will guide you through the process of configuring your music system, and setting up access to your music files.

- If the Desktop Controller software for Windows does not start automatically, run "d:/setup.exe" replacing "d" with your CD-ROM drive's letter as necessary.
- If you have a different operating system, see "System Setup Using Controller".
- If you have only a NAS device without a router, see "Setup Using Only a NAS Device (no router)".

IA at 372; Lambourne Dep. Ex. 1077 at 16.

137. The Sonos System provides for both wireless and wired connections.



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## Adding a ZonePlayer

If your house has structured (built-in) wiring, you can make a 'wired' connection to an additional ZonePlayer. Otherwise, make a wireless connection.

**Caution:** Do not place any items on top of your ZonePlayer. This may impede the air flow and cause your ZonePlayer to overheat.

### When and why should I use a wireless connection?

The Sonos Digital Music system uses a built-in wireless connection to communicate between ZonePlayers. You can place ZonePlayers anywhere without physically connecting them to your computer network, as long as they are within transmitting range (up to 100 ft. depending upon your home's layout). This means that you do not need to go to the effort of installing cables, and you can relocate your ZonePlayer(s) easily.

IA at 373; Lambourne Dep. Ex. 1077 at 17, 18.

138. A user can rename the zones using the desktop controller software or the Sonos controller:

## Renaming a ZonePlayer

If you name a ZonePlayer incorrectly, or if you move your ZonePlayer to another room, you can rename it to suit your preference.

### To rename using Desktop Controller software

1. From the **Zones** menu, click **Set Up Zones**.

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2. Select the ZonePlayer you wish to change, and click **Settings**.
3. From the **Zone Name** tab, select a name from the list, or type a new name for this ZonePlayer in the **Zone Name** field, and then click **OK**.

**To rename using Sonos Controller**

1. From the **Music** menu, select **System Settings>ZonePlayer Settings** and press **OK**.
2. Use the scroll wheel to highlight the zone you wish to change, and press **OK**.
3. Select **ZonePlayer Name**, and press **OK**.
4. Choose one of the following options:
  - Use the scroll wheel to select a new name from the list, and then press **OK**.

Or,

- Type a different name by selecting **Enter New**.
  - Use the scroll wheel to select each letter, pressing **OK** after each entry.
  - Press **Accept** to accept the new name, or press **Cancel** to leave the screen without making a change.

IA at 374-375; Lambourne Dep. Ex. 1077 at 24, 50, 51.

139. The Sonos System can also hide the Zone and unname it to use the ZP just to extend the wireless range of the system:

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## Changing a ZonePlayer's Operating Mode

You can use a ZonePlayer simply to extend the wireless range of your Sonos Digital Music System and not to play music by placing the ZonePlayer into *Sonos Extender* mode. A ZonePlayer operating in Sonos Extender mode is sometimes referred to as a *hidden* ZonePlayer, and will not appear in your **Zones** menu.

The ZonePlayer must already be part of your Sonos Digital Music System in order to change its mode of operation.

### To change using Desktop Controller software

1. From the **Zones** menu, select **Set Up Zones**.
2. Highlight the ZonePlayer you want to change, and click **Settings**.
3. Select the **Advanced** tab.
4. Select either **Normal Mode** or **Sonos Extender Mode**, and click **OK**.

### To change using Sonos Controller

1. From the **Music** menu, select **System Settings>ZonePlayer Settings**.
2. Select the ZonePlayer you want to change, and click **OK**.
3. Select **ZonePlayer Mode**, and click **OK**.
4. Select either **Normal** or **Sonos Extender** mode, and click **OK**.



## Chapter 2: ZonePlayer Setup and Operation

2-9

When a ZonePlayer is in *Sonos Extender* mode, it does not display in your **Zones** menu. When you change it back to normal operation using the **ZonePlayer Settings** screen, it will appear as an *unnamed* zone and you can rename it at that time.

IA at 376-377.

140. The desktop controller main screen shows the following options, which include “zones,” “link zone,” “drop zone,” and others such as line-in, equalizer, and volume:

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IA at 387; Lambourne Dep. Ex. 1077 at 25.

141. Included in these settings are the ability to adjust sound settings for a ZonePlayer and volumes for individual zones within a zone group. Likewise, the system can mute the sound in a zone, or if there is a zone group, all rooms in the zone group would be muted. A user can highlight the zone that he or she wants to mute, mute all zones, unmute all zones, and change equalization settings for zones or zone groups:

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### Equalizer

Use to adjust the sound settings for a ZonePlayer, or to adjust volume for an individual zone within a zone group.



### Mute

Click to mute the sound in a zone (if you have a zone group, all rooms in the zone group are affected).

### *Muting a zone or zone group (DCR)*


1. From the **Zones** pane, click to highlight the zone you want to mute.
2. Choose one of the following options:
  - Click the **Mute** button. To unmute, click the **Mute** button again.
  - From the **Play** menu, click **Mute Zone**. To unmute, click **Unmute Zone**.

### *Muting all zones (DCR)*

You can temporarily mute all of your ZonePlayers at any time. The track will continue to progress, but there will be no sound emitted.

- To mute all the zones in your household, click **Mute All Zones** from the **Play** menu.
- To unmute, click **Unmute All Zones** from the **Play** menu.

### *Adjusting sound settings (DCR)*

1. Highlight a zone in the **Zones** pane, and then click the **Equalizer** button  to change the sound settings (treble, bass, loudness, balance or volume) for an individual ZonePlayer. (You can also select **Equalizer** from the **Play** menu.)
  - To change the volume for a *zone group*, use the group volume control on the left.
  - If you have two or more zones in a group, use the **Equalizer** window to adjust the volume for each zone individually.

IA at 389; Lambourne Dep. Ex. 1077 at 27.

142. If the sound is muted, the track will continue to play. The user may pause the household if a user wants to stop the Sonos System from streaming music generally.

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### Pausing the Household (DCR)

If you want to stop your Sonos Digital Music System from streaming music, click **Pause All** from the **Play** menu. Your ZonePlayers will remain “off” until you click **Play** to restart each zone or zone group.

IA at 389; Lambourne Dep. Ex. 1077 at 45.

143. The Sonos System allows a user to manage zones and zone groups within the system. The user can view the music currently playing in any zone, play a different song in each zone, or can group zones together to play the same music.

### Managing Your Zones (DCR)

The **Zones** pane allows you to view the music currently playing in any zone in your house. You can play a different song in each zone, or you can group zones together to play the same music when you are having a party, or anytime you want the same music selection to play in more than one room. Zones can be managed from either the **Zones** pane or the **Zones** menu. From either of these, you can:

- See an alphabetical list of the zones in your house
- Link zones together to form a zone group
- Drop a zone from a zone group

Music will continue to play while you browse your zone settings. The current zone is highlighted on your screen, and the music selections you make will play in that zone.

IA at 390; Lambourne Dep. Ex. 1077 at 28, 1078 at 2-3.

144. The Sonos System could create zone groups that comprise a group of zones. In a zone group all the zone players coordinate to play the same music in synchrony. The user can link or drop zones from a group while music is playing, and in that scenario any zone linked will automatically drop their current music queue and begin to play the music from the highlighted zone. A user can also link all ZonePlayers with one touch by selecting “All Zones-Party Mode.” Further, if a user selects to link a zone from a zone where there is no music playing, any zones that are linked to it will also be silent.



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## Zone Groups

A zone can be grouped together with any other zone(s) to form a zone group. This will cause all the zones in the zone group to play the same music in synchrony. You can link or drop zones from a group while the music is playing. You can also link all the ZonePlayers in your house with one touch by selecting **All Zones-Party Mode**.

### Linking a zone

You can create a zone group first and then select music to play, or you can add a room to a zone group where music is already playing.

**Note:** Any zones you link will automatically drop their current music queue and begin to play the music queue from the highlighted zone. You may sometimes want to save your music queue as a Sonos playlist before linking a zone. See "Sonos Playlists (DCR)".

1. From the **Zones** pane, highlight the zone you want to link to another zone or zone group.
2. Choose one of the following options:
  - Click **Link Zone**, or
  - From the **Zones** menu, click **Link Zone**.
3. Select a zone to add to the group, and click **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your

IA at 390; Lambourne Dep. Ex. 1077 at 29-31, Lambourne Dep. Ex. 1078 at 3-5.

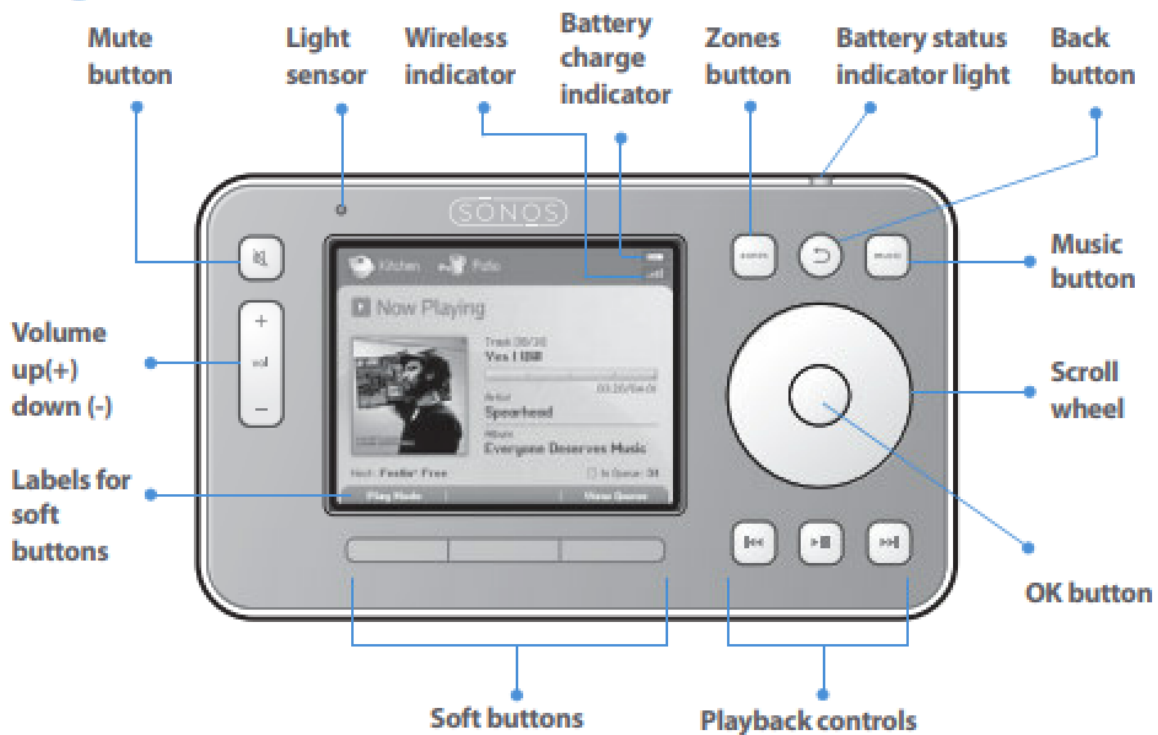
**Note:** The order in which you add zones makes a difference. If you select **Link Zone** from a zone where there is no music playing, any zones you link to it will also be silent.

IA at 391; Lambourne Dep. Ex. 1077 at 29-31, Lambourne Dep. Ex. 1078 at 3-5.

145. The Sonos controller UI is shown as follows, with soft buttons, Zones buttons, a scroll wheel, and other controls:

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## Using the Controller



IA at 436; Lambourne Dep. Ex. 1077 at 60.

146. The Zones button allows a user to select a zone to play music in, view the music selections playing in each room, or to create or modify zone groups to share music across zones synchronously.



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**Controller navigation****Zones**

Use the **Zones** button to select a zone to play music in, to view the music selections playing in each room, or to create or modify *zone groups* in order to share the same music across zones.

**Music**

Use the **Music** button to browse or select music, manage your music queues, access playlists, and change the default settings for a Sonos ZonePlayer or Controller.

**Back**

Use the **Back** button to return to the previous screen.

IA at 436; Lambourne Dep. Ex. 1077 at 60.

147. The user can mute a zone and mute all zones in the house from the controller.

**Controller volume control****Volume Control**

Increases (+) or decreases (-) the volume in any zone, or across a zone group.

**Mute**

Temporarily silences the music in a zone (within a zone group, the mute button automatically mutes the last room where volume controls were adjusted.) Press the **Mute** button again to unmute.

**Mute All**

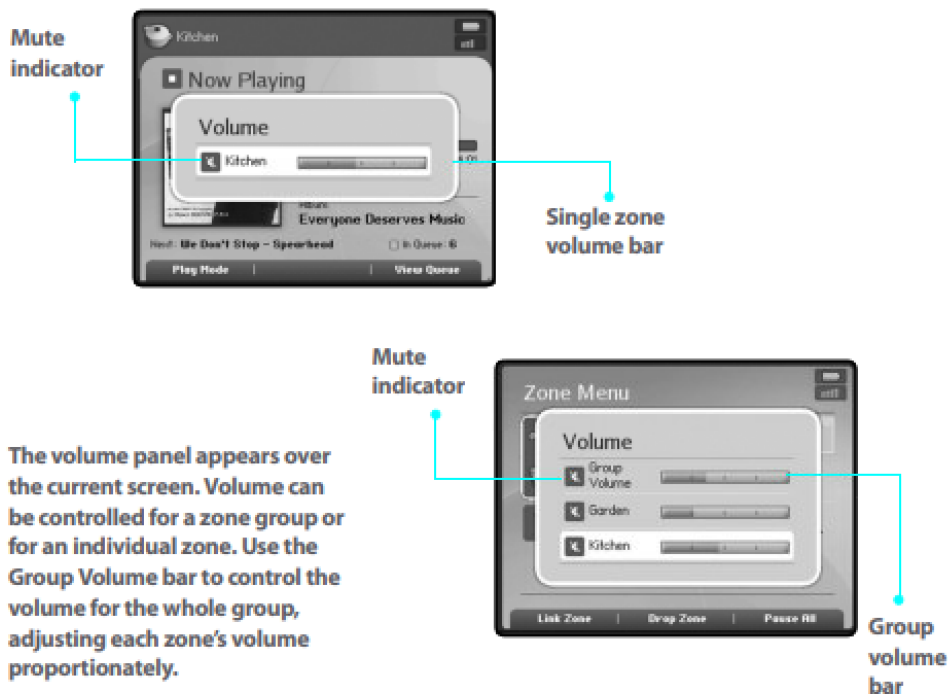
To mute all zones in the house, press and hold the **Mute** button for 3 seconds. To unmute all zones, press and hold again for 3 seconds.

IA at 438; Lambourne Dep. Ex. 1077 at 27, 28, 61, 62.

148. The following diagrams show how a user can control the volume of zone groups that the user creates.

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## Controller - Volume Settings



1. From the **Zone** menu, use the scroll wheel to highlight the zone you want to change the volume settings for.
2. Use the **Volume Up** and **Down** buttons to change the volume to the desired level.
3. Touch **OK**, and the Volume panel disappears.

### Muting zone or zone group

- To mute a zone or a zone group, touch the **Mute** button (within a zone group, the mute button automatically mutes the last room where volume controls were adjusted.)
- Touch the **Mute** button again to unmute.

IA at 440; Lambourne Dep. Ex. 1077 at 12, 27.


149. The user can manage the zones and zone groups using the Sonos controller. The user can see an alphabetical list of the zones and which music has been selected for each zone, group zones together into zone groups, drop zones from a group, and turn the system off.

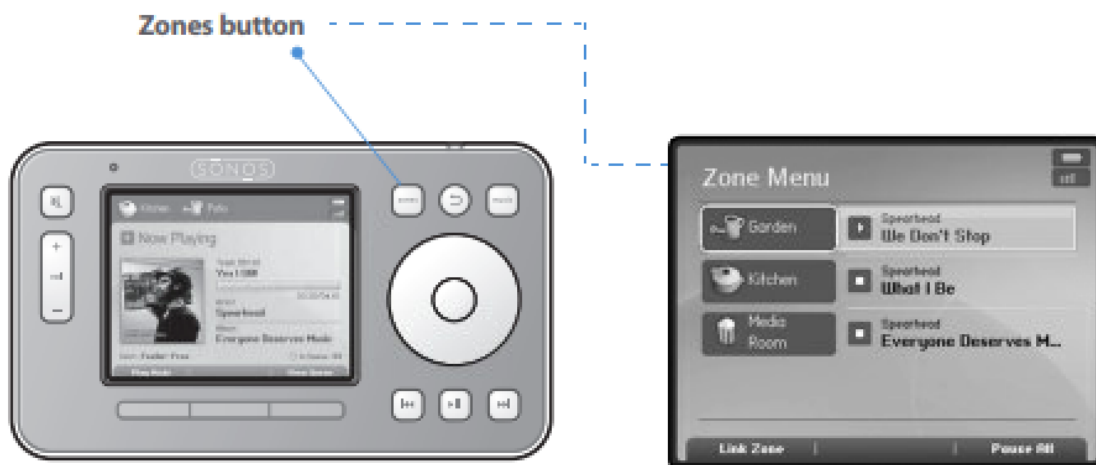
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## Managing Zones Using Controller

Press the **Zones** button on your Controller to:

- See an alphabetical list of the zones in your household, along with the music currently playing in each zone
- Group zones together to play the same music across zones (create a *zone group*)
- Drop a zone from a zone group
- *Turn off* your music system

Music continues to play while you browse the **Zone** menu. Use the scroll wheel to highlight a zone, and touch **OK**. The **Now Playing** window appears. You can then press the **Music** button  to change the music selection for that zone.



**Touch the Zones button to view the music playing in each room**

IA at 442; Lambourne Dep. Ex. 1078 at 2-3.

150. The user can group zones together in “with any other zone” to form a zone group. The user can link and drop zones while music is playing, and the music within the group will play synchronously throughout the group. Zones added to a group will begin playing the music that was playing in the zone group.

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**Zone groups**

A zone can be grouped together with any other zone(s) to form a zone group. This will cause all the zones in the zone group to play the same music in synchrony. You can link and drop zones from a zone group while your music is playing. You can also link all the ZonePlayers in your house with one touch by selecting **All Zones-Party Mode**.

**Note:** Any zones you add to a group will automatically drop their current music queue and begin to play the music that is playing in the zone group. You may sometimes want to save your music queue as a Sonos playlist before linking zones. See Saving a Sonos Playlist.

**Linking a zone**

1. Press the **Zones** button on your Controller.



2. Highlight the zone or zone group that you want to add a zone to, and touch **Link Zone**.

**Note:** The order in which you add zones makes a difference. If you select **Link zone** from a zone where there is no music playing, any rooms you link to it will also be silent.

3. Highlight the zone you want to add to the group, and touch **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your ZonePlayers will then play the same music in synchrony.

IA at 443; Lambourne Dep. Ex. 1078 at 2-4.

151. There are a number of settings for the ZonePlayer accessible through the controller, including equalization, naming, line-in and line-out, and ZonePlayer mode.

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## ZonePlayer Settings



### Music Equalization

You can change the sound settings (treble, bass, loudness, or balance) for each individual ZonePlayer.

1. From the **Music** menu, select **System Settings>ZonePlayer Settings**, and touch **OK**.
2. Use the scroll wheel to select a zone, and touch **OK**.
3. Select **Music Equalization**, and touch **OK**.
4. Select a setting, and then use the scroll wheel to make adjustments to the control slide that appears on the screen, and then touch **OK**.
5. To change the settings for a ZonePlayer back to their original default values, select **Reset All**.

### Renaming ZonePlayers

1. From the **Music** menu, select **System Settings>ZonePlayer Settings** and touch **OK**.
2. Use the scroll wheel to highlight the ZonePlayer name you wish to change, and touch **OK**.
3. Select **ZonePlayer Name**, and touch **OK**.

IA at 455; Lambourne Dep. Ex. 1078 at 13-14; Lambourne Dep. Ex. 1077 at 24, 50; Lambourne Dep. Ex. 1078 at 12, 18.

152. The user can select a new name from a list of available names, or the user can enter a unique name by manually entering a new name.

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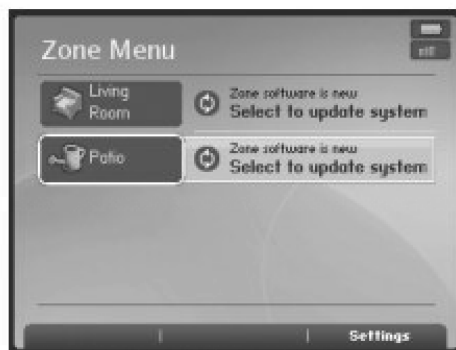
4. Use the scroll wheel to select a new name from the list, and then touch **OK**.
5. You can also type a unique name by selecting **Enter New**.
  - Use the scroll wheel to select each letter, touching **OK** after each entry.
  - Touch **Accept** to accept the new name, or touch **Cancel** to leave the screen without making a change.

IA at 456; Lambourne Dep. Ex. 1077 at 24.

153. The ZonePlayer may receive software updates from Sonos.

#### **ZonePlayer software updates**

If a ZonePlayer's software version gets out of sync from the rest of your Sonos Digital Music System components, you will see the following message displayed on your **Zones** menu:



*One or more ZonePlayers may need to be updated if you purchase a new ZonePlayer with a later software version, or if you plug in a ZonePlayer that was not in use when you performed your last software update.*

*You will also see this message if you have already updated your music system using the Controller. This message will indicate that the Desktop Controller software needs to be updated.*

IA at 460; Lambourne Dep. Ex. 1077 at 42-44, 50, 52; Lambourne Dep. Ex. 1078 at 22, 23, 24.

154. The Sonos System can also provide “about” information, including dates of the software, version numbers, serial numbers, etc. The dates below pre-date the ’885 and ’966 patents.

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## About Your Music System

If you make a call to Sonos Customer Support, you may be asked for specific details regarding your Sonos Digital Music System. You can find this information by choosing one of the following options:

- From the **Music** menu on your *Sonos Controller*, select **System Settings>About Your Digital Music System**.



Or,

- From the *Sonos Desktop Controller for Macintosh* menu bar, click **Sonos>About Sonos**.



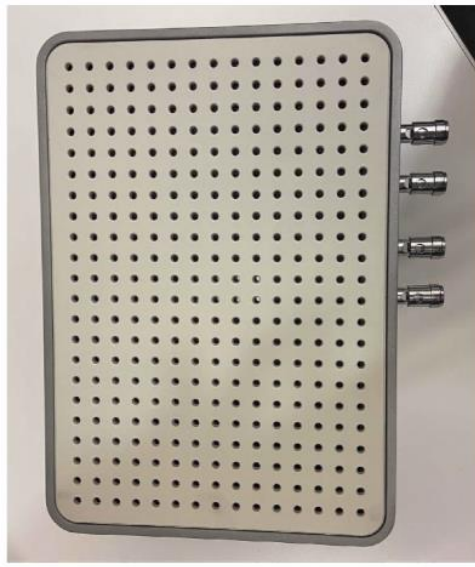
IA at 473-474; Lambourne Dep. Ex. 1078 at 34.



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155. I understand that Google requested several times from Sonos that Sonos make available controller devices, zone player devices, along with the corresponding firmware and software from prior to September 12, 2005, but that Sonos has maintained it was not possible to load and compile 2005 source code for the requested devices, and that it was unable to locate any CR100 devices that it believed would be operable to load the requested firmware. *See e.g.*, email from C. Richter to A. Aubry date August 23, 2022.

156. Nonetheless, I have inspected Sonos players that have been made available for inspection in this case.





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GOOG-SONOSNDCA-00056791-801.

157. In order to understand the design and operation of the Sonos System, I have also analyzed source code that I understand reflects the operation of the Sonos System that was released before Sonos's alleged invention date.

### **3. The Sonos Webpage**

158. I understand that the Sonos Webpage was published no later than March 22, 2005 or May 5, 2005, making it prior art under at least 35 U.S.C. § 102(b) and 102(a) for the same reasons discussed above. *E.g.*, IA at 141. The Sonos Webpage describes the Sonos System that is prior art under at least those same sections.

159. The Sonos Webpage is a publication describing features similar to those of

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Millington (WO 2005/013047), including a handheld controller with a user interface. The user interface, shown below, allows for “scrolling through your music library, browsing titles, viewing album art, queuing up tracks, choosing zones, and more, the large, full-color LCD screen and scroll wheel make it a real cinch.” IA at p. 141. A user can also use the user interface to “build a separate queue of music to play in each zone or group of zones in your house” and “control what zone or group of zones plays the music selected, and set shuffle/repeat playback as desired.” IA at p. 137.



IA at p. 141 (annotated).

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## It's like having a giant jukebox of music at your fingertips.

Now you can have instant access to your entire digital music collection, including all your playlists, from anywhere in your home — inside or out. That's because the Sonos™ Controller uses Sonosnet™, our secure wireless mesh network that extends the range of your Controller throughout your entire home. Which means you don't have to run to your PC every time you want to turn on, change or turn off your music. And, you can control everything from volume to music selection in any room from anywhere.




\$399.00 USD

[more images](#)[Order Now](#)

When it comes to scrolling through your music library, browsing titles, viewing album art, queuing up tracks, choosing zones, and more, the large, full-color LCD screen and scroll wheel make it a real cinch. No other digital music system lets you do all that.

*Id.* (annotated).

Controller Features		Specifications 
Feature	Description / Benefit	
Wireless, handheld control		
Integrated, multi-room control	Lets you control what music is playing in every room in your house, from anywhere in your house. Control of your music is not tied to the room where you're listening.	
Sonosnet™	A secure, peer-to-peer wireless mesh network that extends the range of the Controller to any room in your house, even outside. Avoids sources of wireless interference by communicating with the closest ZonePlayer, rather than through one distant control point.	
Multiple options for music selection	Browse your digital music collection by Artist, Album, Genre, Track Name, Composer, or Playlist.	
Queue-based music playback	Makes it easy to build and edit lists (queues) of songs to play, and to save lists for future playback.	
Multiple music queues	Lets you use any Controller to build a separate queue of music to play in each zone or group of zones in your house.	
Flexible playback options	Control what zone or group of zones plays the music selected, and set shuffle/repeat playback as desired.	
High-capacity Lithium Ion battery	Lasts for over a week between battery charges, assuming typical usage.	
Full-color LCD screen and scroll wheel		
High-resolution color screen	Makes everything on the screen brighter and easier to see, including full-color album artwork, if available.	
Scroll wheel selector	Makes it quick and easy to scroll through large music collections and make selections.	
Intuitive button layout	Provides complete music management and control. Two buttons are dedicated to providing direct access to the Controller's main menus (Music and Zones).	
Movement sensor	Automatically turns the Controller on when you pick it up.	
Backlit buttons and screen	Backlit buttons and screen make the Controller easy to operate in low-light conditions.	
Light sensor	Turns backlighting on only when necessary to conserve battery power.	

*Id.* (annotated).

160. The Sonos webpage discloses different genres of digital music in many different

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“rooms” such as the kitchen, living room, playroom, or the lawn:



IA at 119.

161. The Sonos webpage further discloses listening to music in “two rooms of your house” with an introductory bundle, and the ability to “simply add more ZonePlayers as needed”:




IA at 121.

162. The Sonos webpage notes that the Controller is a full-color LCD controller with a

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scroll wheel that lets a user control all the music and “all” zones from anywhere in the home:


Sonos™ Controller CR100



**Description:**  
Wireless handheld controller with full-color LCD screen and scroll wheel that lets you control all your music and all your zones from anywhere in your home. Provides instant access to your entire digital music collection from the palm of your hand.

[Learn more](#)


Price: \$399.00

 Add to My Cart

IA at 121.

163. The Sonos webpage notes that the ZonePlayer 100 “distributes, plays, and amplifies” music “all throughout” the home and includes Sonos System Setup Software.


Sonos™ ZonePlayer ZP100



**Description:**  
Networked audio player that distributes, plays and amplifies your music all throughout your home — regardless of where your music is stored. Includes Sonos System Setup software.

[Learn more](#)

Price: \$499.00

 Add to My Cart

IA at 121.

164. The Sonos webpage notes that the system allowed a user to play any song in any of the user’s rooms, regardless of where the music was stored:



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## Play any song. In any room. From anywhere.

Sonos is the first and only digital music system that lets you play all your digital music, all over your house—and control it all from the palm of your hand. Best of all, you don't need a PC in every room, a music server or a wireless network. Just a Sonos™ ZonePlayer and speakers in the rooms of your choice and a Sonos™ Controller in hand to access all your digital music, no matter where it's stored—on your PC, Mac or Network Attached Storage box.

### With a Sonos™ Digital Music System you can:

- Simultaneously play the same song or different songs in as many rooms as you'd like — up to 32.
- Easily access your entire digital music collection with a full-color LCD screen and scroll wheel.
- Wirelessly control all your music and all your rooms—from anywhere with Sonosnet™.
- Enjoy great sound in every room.



IA at 123.

165. The Sonos webpage notes that “a room doesn’t always define the space where you want to listen to music—think living room + dining room . . . .” The Sonos webpage also notes that the Sonos System can play “the same song simultaneously in different zones without echoes or delays” as well as play “different songs simultaneously in different zones.”

## It distributes. It plays. It amplifies.


The Sonos™ ZonePlayer brings great sounding music to any and every room in your house—regardless of where your music collection is stored. And we do mean every room. In fact, you can play the same song or different songs in as many rooms as you'd like. Simultaneously. No other digital music system lets you do that.

If you're still wondering why we called it a ZonePlayer rather than a room player, the answer is simple: a room doesn't always define the space where you want to listen to music—think living room + dining room, not to mention your backyard, garage and swimming pool.



[+ more images](#)

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ZonePlayer Features		Specifications 
Feature	Description / Benefit	
Multi-room digital music		
Built-in wireless capability	Connects ZonePlayers wirelessly when a wired Ethernet connection is not available.	
Sonosnet™	A secure, wireless mesh network that streams music wirelessly to other ZonePlayers, avoiding sources of wireless interference.	
Multi-zone synchronous playback	Plays the same song simultaneously in different zones without echoes or delays.	
Multi-stream playback	Plays different songs simultaneously in different zones.	

IA at p. 125.

166. The Sonos webpage notes that the PC and Mac software provided with the Sonos System offered the same or similar controls as provided in the Controller including, as shown below, the ability to group zones and play music.

### It's the software to help get you started.

- [PC software](#)
- [Mac software](#)

#### PC Software

Designed with a user interface to accommodate a larger screen, the Sonos™ Desktop Controller software will guide you through both set up and music sharing. It offers all the same functionality as the Sonos™ Controller, but instead of being in the palm of your hand, it's all on your desktop.

#### Features

- Easy-to-use Assistant for set up and music sharing. Set up music folders on your hard drive so they can be shared across all ZonePlayers.
- Control of your Sonos™ Digital Music System from your desktop.
- Add and edit your choice of Internet radio stations.



[View large image](#)

IA at p. 129.

167. The Sonos webpage describes that the Sonos System may be set up in multiple zones, controlled from a controller, and play music synchronously in those zones:



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IA at p. 135.

168. The Sonos Webpage is analogous to the '885 and '966 patents because it is in the same field of endeavor, “controlling or manipulating a plurality of multimedia players in a multi-zone system.” '885 patent at 1:30-34. For example, the Sonos Webpage, like the '885 and '966 patents explains that it is directed to a “digital music system that lets you play all your digital music, all over your house—control it all from the palm of your hand.” IA at p.123. The Sonos Webpage is also reasonably pertinent to the problem to be solved by the '885 and '966 patents, “dynamic control of the audio players as a group.” *E.g.*, '885 patent at 2:18-24. For example, the Sonos Webpage explains that its disclosures allow a user to group playback devices so that “you can play the same song or different songs in as many rooms as you’d like. Simultaneously.” IA at p. 125, 127, 129, 131.

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#### **4. Evidence Considered for the Sonos System**

169. Dr. Almeroth is correct that my invalidity theory for the Sonos System is based on the functionality of a commercially-available Sonos multi-zone audio system in 2005, and specifically the functionality of Sonos ZP100 players in combination with a CR100 controller, both of which were commercially available in 2005.

170. In addition to the documents referenced in Sections VIII.A.1-3 above, I also considered several CR100 and ZP100s, produced as GOOG-SONOSNDCA\_PROD063-064 (GOOG-SONOSNDCA-00117906-914).

171. I also note that based on Dr. Almeroth's validity report (July 27, 2022), Dr. Almeroth and Sonos argued I had not established that the physical Sonos products were publicly available prior to the September 12, 2005 critical date or the December 2005 invention date, nor had I established that these physical Sonos products were loaded with prior art firmware. Almeroth Rebuttal Report at ¶¶277-280. As I mentioned above, Sonos itself did not make available controller devices and zone player devices, along with the corresponding firmware and software from prior to September 12, 2005, because Sonos maintained it was not possible to load and compile 2005 source code for the requested devices, and that it was unable to locate any CR100 devices that it believed would be operable to load the requested firmware. *See e.g.*, email from C. Richter to A. Aubry date August 23, 2022. I have established that the CR100 controller and ZP100 zone player were available at least as early as April 2005, and Sonos has set forth no evidence that the source code available would not have been compatible with the Sonos products available in this timeframe, including the CR100 controller and ZP100 zone player.

172. Nonetheless, Sonos argued I had not established that the functionality I observed accurately reflected how the Sonos System actually functioned at a time that would qualify as prior art. Almeroth Rebuttal Report at ¶¶277-280.

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173. Dr. Almeroth specifically identifies a January 2006 Sonos User Guide that he contends is not prior art. Dr. Almeroth does not contend that this user guide does not reflect the functionality of the prior art products (available one month prior), nor does he contend that the disclosures of this user guide differ substantively from that of prior Sonos user guides, which are indisputably prior art, and upon which I also rely. Almeroth Rebuttal Report at ¶278.

174. Dr. Almeroth also specifically identifies a July 11, 2006 printout of Sonos's webpage describing the ZP80 product. As I discussed immediately above, Dr. Almeroth does not identify any substantive differences between the disclosures in this document, which describe the prior art products, and those dated prior to December 2005. Almeroth Rebuttal Report at ¶279.

#### **B. The Sonos Forums**

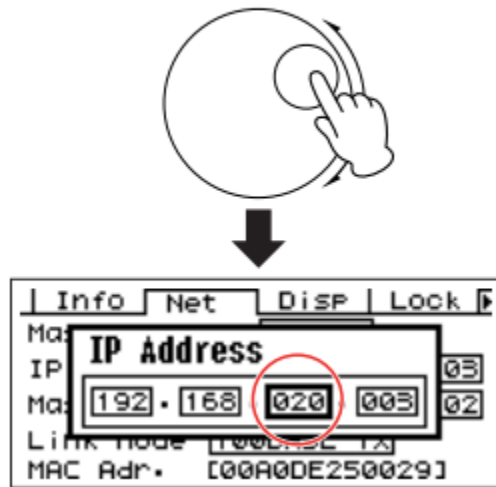
175. I understand that the Sonos Forums were publicly available at least as of September 2005, making them prior art under 35 U.S.C. 102(a), 102(b), and 102(f).

176. Mr. Farrar, who was employed in customer support at Sonos, worked on and has testified to the Sonos Forums. Farrar Dep. Tr. at 38:19-24; 48:23-49:2. He posted on the Sonos Forums and had roughly 824 replies to Forum posts. *Id.* at 51:2-15; Ex. 5. He also testified that he did not have reason to believe that the dates on the exhibits introduced at his depositions—which were prior art Sonos Forum posts—were inaccurate. *Id.* at 52:5-54:5.

177. In the Forum Post entitled “Macro / presets,” users suggested various features for the Sonos products. Farrar Dep. Ex. 6. I have excerpted certain posts within this thread below. First, however, I note that as annotated below, this Forum post predates the earliest claimed priority date of the '885 and '966 patents as well as Sonos's claimed invention date, which is shown by hovering over the date of those posts.

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2. Rotate the dial to edit the value as required.



DME Manual at 497.

## XI. INVALIDITY OF '885 PATENT BASED ON ANTICIPATION AND OBVIOUSNESS

266. It is my opinion that Claim 1 of the '885 patent is anticipated and/or rendered obvious by the prior art as explained in detail below.<sup>6</sup>

### A. Obviousness In View of the Prior Art Sonos Products ("Sonos System")

267. As I discussed above, the Sonos System, including a CR100 and multiple ZP100 zone players was publicly available, on sale, offered for sale, and described in printed publications both before the critical date (*i.e.*, prior to September 12, 2005), before the alleged conception date (*i.e.*, prior to December 21, 2005), and prior to the patent filing date on September 12, 2006. The features offered in that system were substantially the same during each of those time frames, as

<sup>6</sup> I understand that Sonos is no longer pursuing infringement of any claims other than claim 1 of the '885 patent. 2022-11-15 Email from Sullivan to Cooper ("To the extent that this was not clear from our expert issue list, please be advised that Sonos is no longer asserting any claims of the '885 Patent other than Claim 1."). I reserve my right to offer opinions on invalidity of claims other than claim 1 in light of new information or changes in the posture of the litigation.

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discussed below.

268. The capabilities and features of the Sonos System are apparent from source code that Sonos has made available for inspection, the products themselves, technical documentation that Sonos has made available, public documentation regarding that system, professional and customer reviews, and other sources discussed below.

269. In my opinion, Claim 1 is rendered obvious based on the Sonos System in view of the general knowledge of a POSITA, the Sonos Forums, Nourse, and Millington, as described below. Below, I analyze each limitation of Claim 1 and demonstrate why that claim is invalid.

## **2. Limitation 1 (preamble): “A first zone player comprising:”**

270. To the extent the preamble is limiting, the Sonos System discloses the preamble in my opinion. For example, Sonos’s User Guide for the “Sonos Digital Music System” (*i.e.*, the Sonos System) is dated April 2005. Lambourne Dep. Ex. 1077 at 2; Lambourne Dep. Tr. at 164:4-25 (not disagreeing with date). Sonos describes the “ZonePlayers” in the Sonos Digital Music System throughout that document.

It's the first and only multi-room digital music system with a wireless, full-color LCD screen Controller. This means you can now enjoy all your digital music, all over your home, and control it all from the palm of your hand.

With a Sonos Digital Music System you don't need a computer in every room, a music server, or a wireless computer network. Just a Sonos ZonePlayer and speakers in the rooms of your choice, and a Sonos Controller in hand to access all your digital music - no matter where it's stored.

Now you really can store your music wherever you please - on your computer, music server, network-attached storage (NAS) box, or even an external source like a CD player. Best of all, you can listen to music wherever you have Sonos ZonePlayers - in the bedroom, on the deck, or both.

*E.g., id.* at 5.

271. Sonos identifies the ZP100 as an example of a Zone Player (*i.e.*, ZonePlayer 100).

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# ZonePlayer Setup and Operation

## ZonePlayer Package Contents

- Sonos ZonePlayer ZP100
- Sonos System Setup software CD-ROM
- Ethernet (network) cable
- Power cord
- Setup Instructions

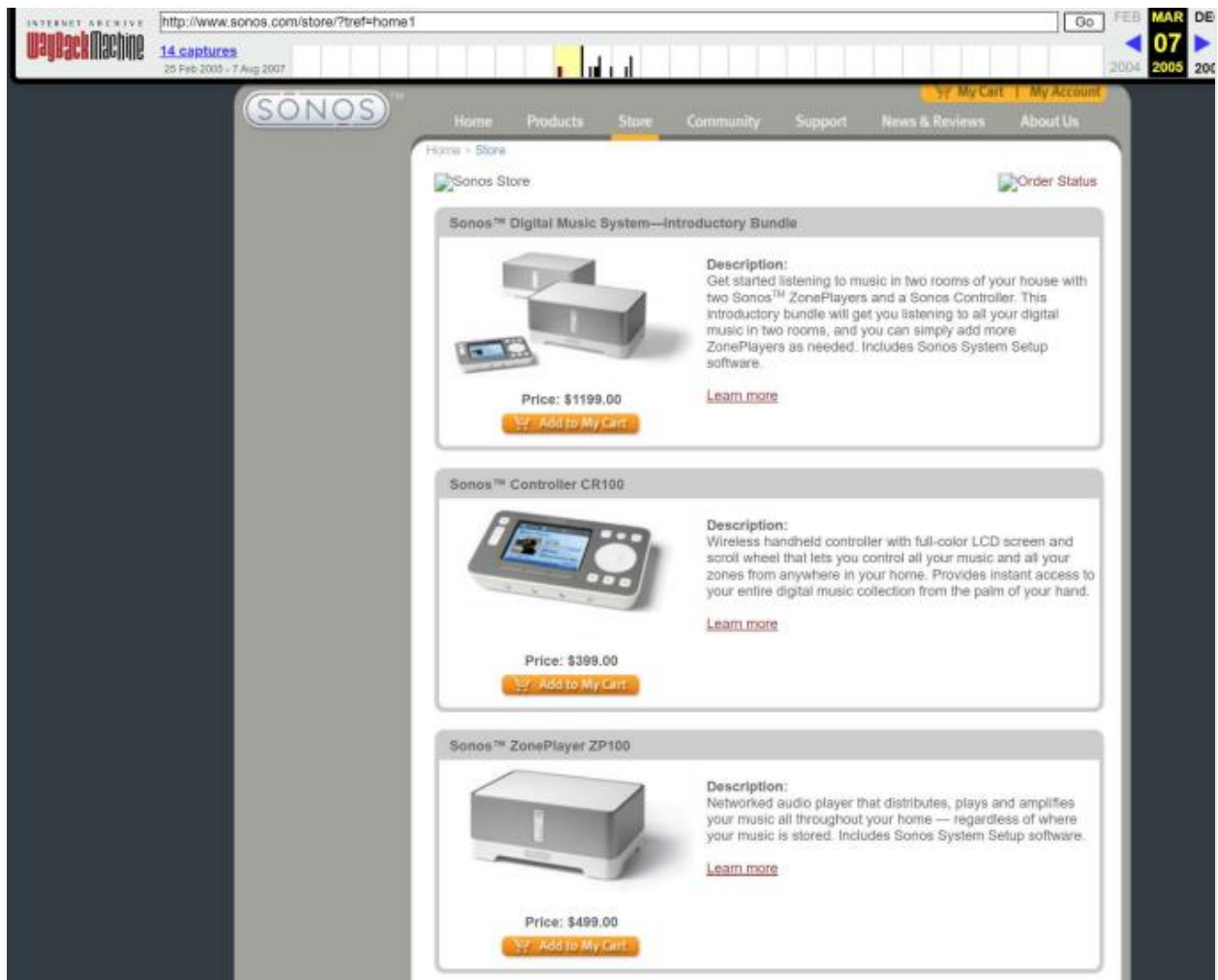
## Where to Begin

Carefully unpack your Sonos ZonePlayer(s). Then follow the step-by-step instructions on the following pages to ensure that you set up your speakers and your ZonePlayer(s) correctly.

*E.g., id.* at 11.

272. Sonos advertised and sold this Zone Player prior to the critical date.

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IA at 121.



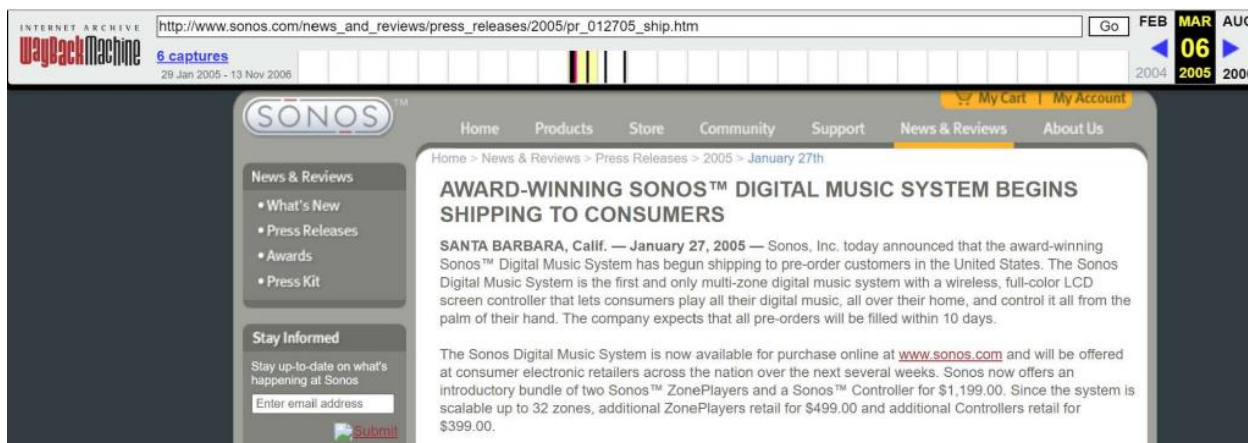
IA at 123.



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IA at 164.



IA at 177.

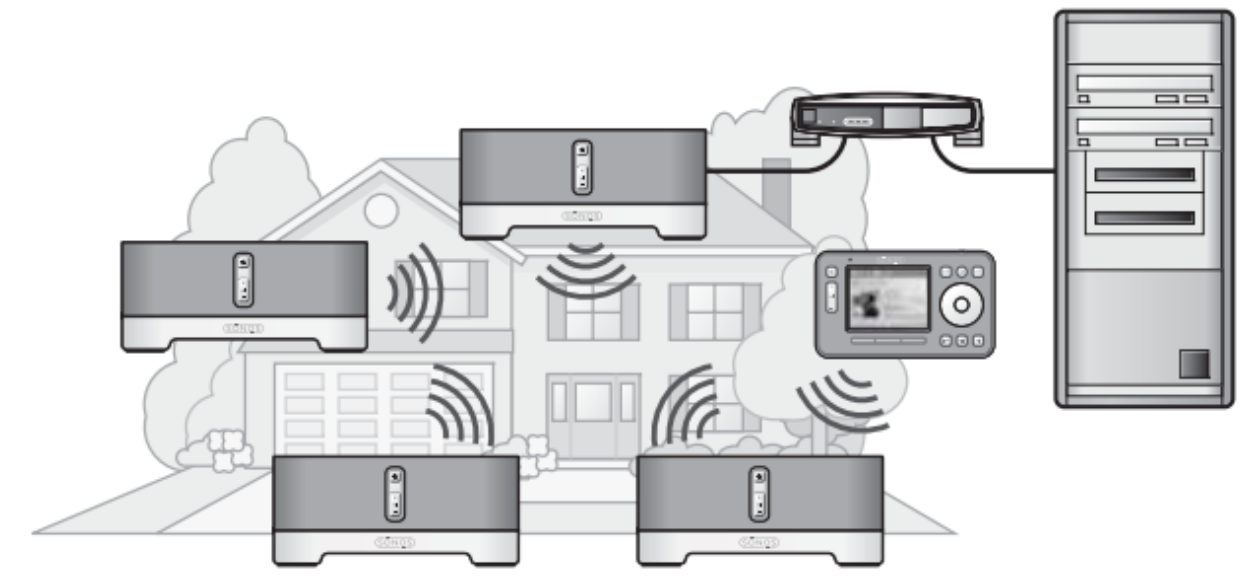
273. I understand that Sonos does not dispute that the Sonos System discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over the Sonos System. I have reviewed Sonos's response ("Validity Contentions") as it relates to the Sonos System and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp.

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Rsp. To Google's First Set of Rogs) at 85-86.

**3. Limitation 1.1: “a network interface that is configured to communicatively couple the first zone player to at least one data network;”**

274. In my opinion, the Sonos System discloses this claim limitation. For example, Sonos's User Guide for the “Sonos Digital Music System” (*i.e.*, the Sonos System) is dated April 2005. LambourneDep. Ex. 1077 at 2; *supra*. Sonos describes the Zone Players as communicating over a wireless Wi-Fi network and wired Ethernet.



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## Your Computer Network

To play the digital music files stored on your computer, your computer network must meet the following requirements:

### *Network requirements*

- You must have an Ethernet network interface connection in your computer. If you do not have one, you will need to buy and install a Network Interface Card (NIC) before proceeding.
- DSL/cable modem, or LAN-based, high-speed Internet connection recommended.
- If you have a cable or DSL modem connected directly to your computer, **you should have a router connected between your modem and your computer** to maintain your computer's security. If you do not have a router, you should buy and install one before proceeding.

## Where to Begin

Carefully unpack your Sonos ZonePlayer(s). Then follow the step-by-step instructions on the following pages to ensure that you set up your speakers and your ZonePlayer(s) correctly.



**Note:** If you should experience any difficulty during the setup process, see Appendix A for additional help.

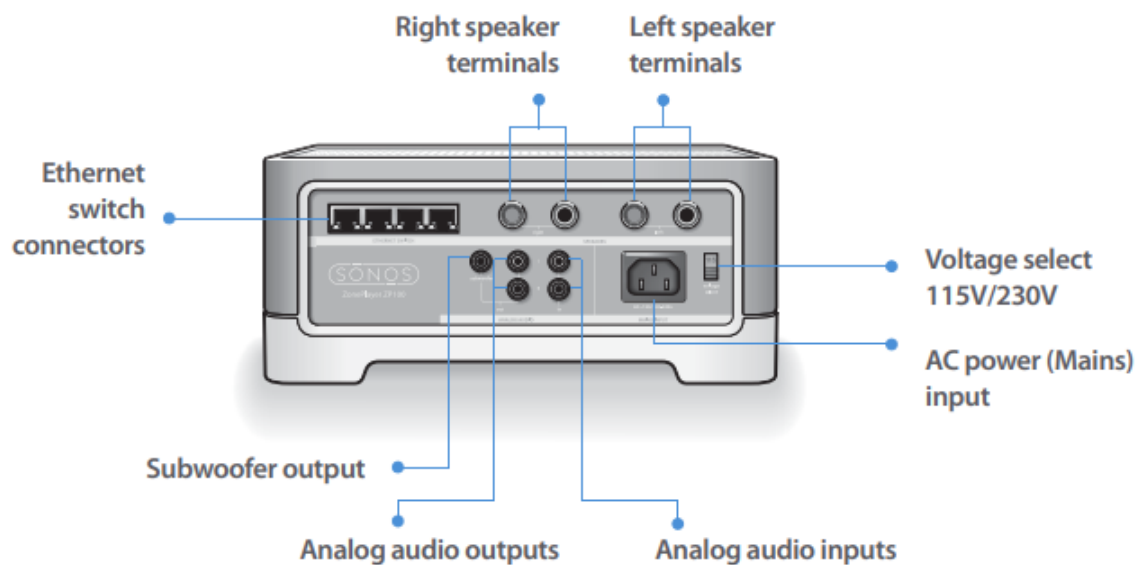
## 1-2-3 Setup

It takes just 3 steps to get your Sonos Digital Music System up and running:

- 1 Connect speakers to your ZonePlayer
- 2 Connect the first Sonos ZonePlayer (with Ethernet cable supplied) to your home network
- 3 Install the computer software (or use a Controller) to configure your music system

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## Rear Panel Connectors



### Ethernet switch connectors (4)

Use Category 5 Ethernet cable to connect to a router, computer, or additional network device such as a network-attached storage (NAS) device.

#### LED indicators:

- Green (link connection)
- Flashing Yellow (network activity)

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## 2 Connect First ZonePlayer

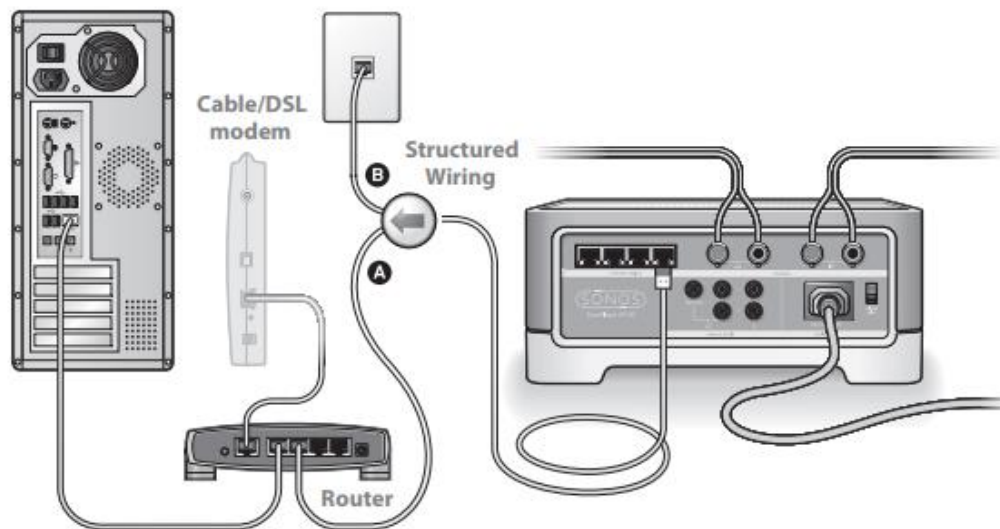


**Note:** The first ZonePlayer you install must connect to your home network using a standard Ethernet cable (supplied). If your computer only has a wireless connection, go to <http://faq.sonos.com/wireless> for assistance.

1. Connect the Ethernet cable from an open port on your router to any of the four (4) Ethernet switch connectors on the back of your ZonePlayer (see **A** in the diagram below).
  - **If your modem is currently plugged into the only network interface connector on your computer, you should install a router before continuing. If you don't have a router, go to <http://faq.sonos.com/norouter> for instructions.**

Or,

If you have structured (built-in) wiring that connects to a router located elsewhere in your home, you can connect the Ethernet cable from a live wall plate into one of the four Ethernet switch connectors on the back of your ZonePlayer (see **B** in the diagram below).



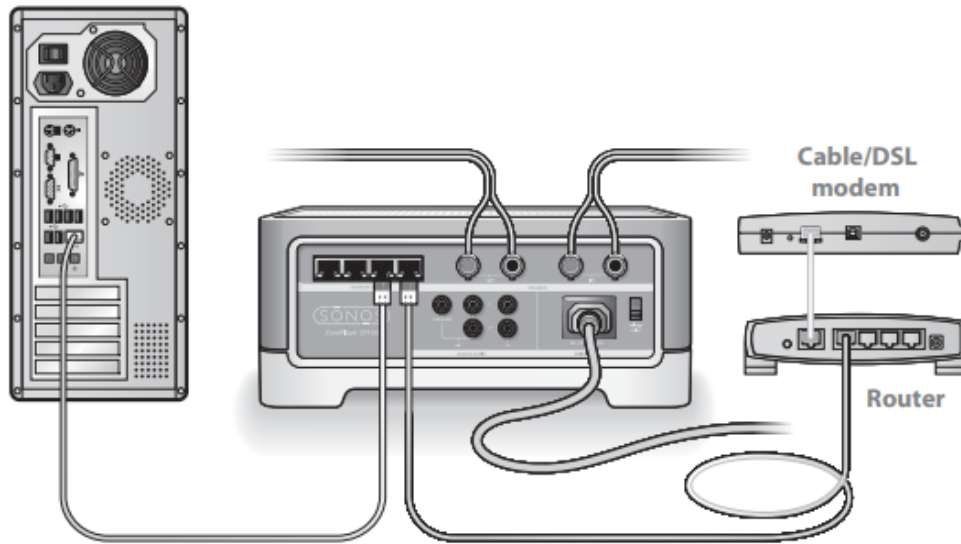


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**Note:** To maintain your computer's security, do not connect the ZonePlayer directly to your cable/DSL modem.

2. If you don't have an open port on your router, you can disconnect your computer from the router and connect it to the ZonePlayer instead. Then you can connect the ZonePlayer into the router port the computer was previously plugged into.



### *When and why should I use a wireless connection?*

The Sonos Digital Music system uses a built-in wireless connection to communicate between the various ZonePlayers. You can place ZonePlayers anywhere you wish without physically connecting them to your computer network, as long as they are within transmitting range (up to 100 ft. depending upon your home's layout). This means that you do not need to go to the effort of installing cables, and you can change the location of your ZonePlayer at any time.

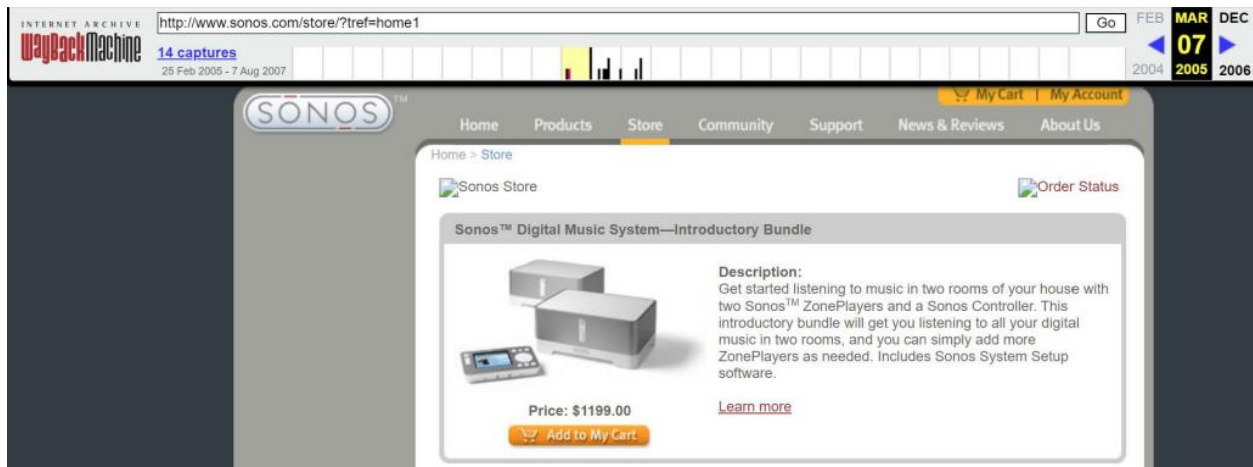
Use wireless connections when:

- You do not want to install network cables
- You may want to move the location of the ZonePlayer
- There is enough signal strength for the ZonePlayer to transmit and receive data reliably

Lambourne Dep. Ex. 1077 at 6-17.

275. The Sonos System is described by Sonos throughout its documentation as a “digital” system, and therefore meets Sonos’s proposed construction as well as Google’s.

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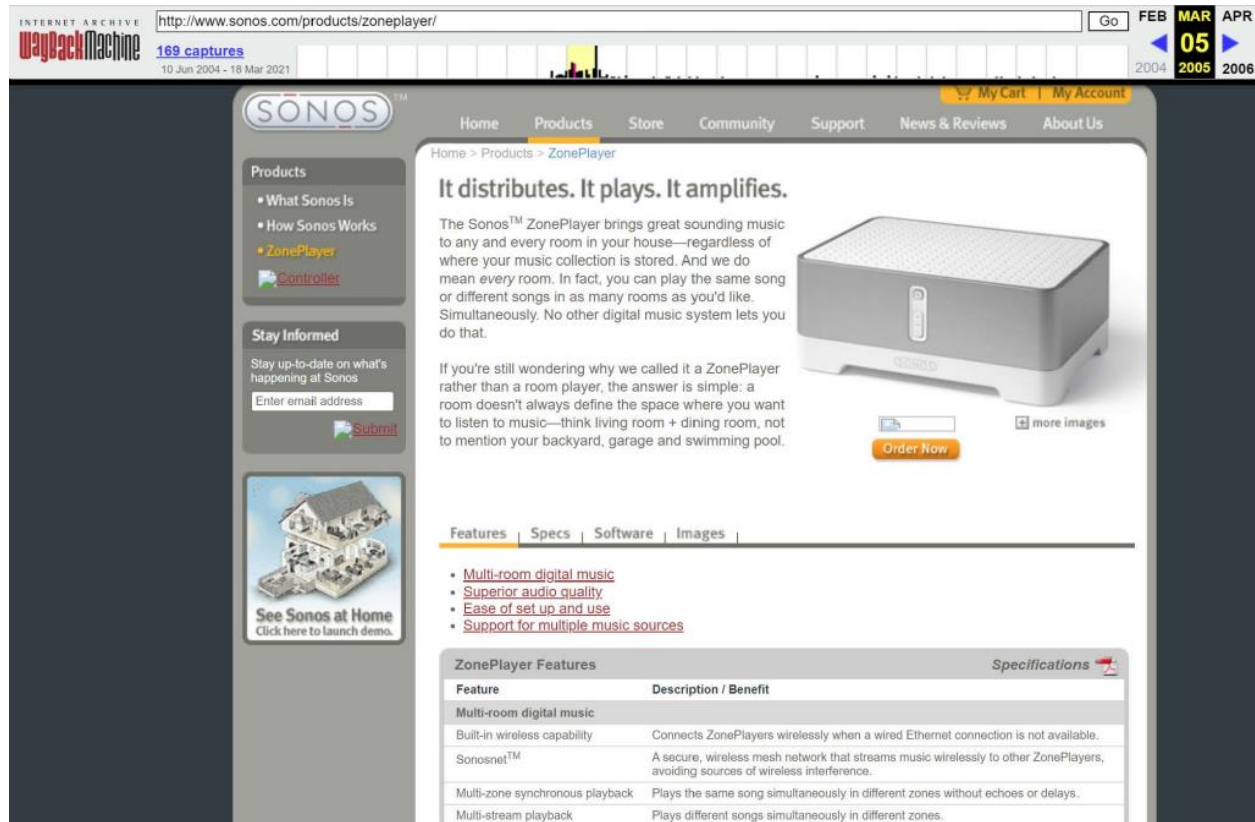
IA at 121.



IA at 123.



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IA at 125.

276. Further, the source code reveals that this claim limitation is met. On startup, the first Zone Player brings up a Linux wireless interface (ath0) in infrastructure mode, configured with a WEP key and channel. The first Zone Player also configures and starts up a Linux bridge interface (br0), configured to bridge a Linux Ethernet interface (eth0) with wireless PTP tunnels. See, e.g.:

1. sysinit state invokes /etc/Configure script, V1.2\gold\rootfs\zp\sh4\etc\inittab, 1

2. configuration of network interfaces (ath0, br0, eth0), rootfs\zp\sh4\etc\Configure, 43–45, 47–52, 57–59 66–68, 70–83, 87–91

3. rssi\_monitor\_thread\_infra(), V1.2\gold\cc\atheros\driver\infra.c, 1294–1536 at 1319–1320, 1347–1369

277. I understand that Sonos does not dispute that the Sonos System discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's

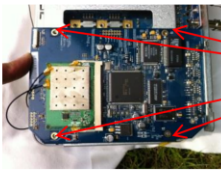
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contentions for why Claim 1 of the '885 patent is not invalid over the Sonos System. I have reviewed Sonos's response ("Validity Contentions") as it relates to the Sonos System and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rgs) at 85-86.

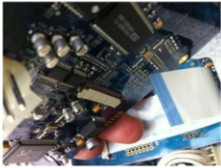
#### 4. Limitation 1.2: "one or more processors;"

278. In my opinion, the Sonos System discloses this claim limitation. As shown in teardowns of the ZP100, the system includes a motherboard with multiple processors.

## Network card



**1 – Remove the 4 top screws**



**2 – Unplug the power connector**

**3 – Unplug the ribbon connector (release by gently pulling the end clamp clips forward)**

[http://www.mediafire.com/file/0duavcuf1zyuc8u/sonos\\_dismantle.pdf/file?dkey=0duavcuf1zyuc8u](http://www.mediafire.com/file/0duavcuf1zyuc8u/sonos_dismantle.pdf/file?dkey=0duavcuf1zyuc8u); <https://en.community.sonos.com/advanced-setups-229000/sonos-zp100-dismantle-and-possible-repair-guide-35389>.

279. Further, Sonos's documentation discloses that the software running on the ZP100 and Sonos's other prior art zone players could be reprogrammed or updated. Accordingly, that software is executed by processors within the Zone Player as claimed.

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## Getting Software Updates

Sonos periodically provides you with software updates to improve performance or to add new features. Your music system must be registered in order to receive updates.

There are two preference options available:

- Do not automatically check for updates. From the **Music** menu, you should periodically select **System Settings**→**Online Updates** to check for software updates.
  - Send a message when an update is available. (To change your preference setting, see "Auto check for software updates" on page 5-29.) The message, "Update Available" will appear on the **System Settings** menu next to **Online Updates** to indicate there are new Sonos updates available.
1. Touch **OK** to contact Sonos.
  2. If there is an update available, select **Yes** to begin the update process.

Your ZonePlayers and the Controller will be updated together as all Sonos components must carry the same software version number. This process may take several minutes per device, depending upon your network connection. Because this process can run unattended, Sonos recommends you start the update when you will be away from your Sonos Digital Music System for a period of time. If you have the Desktop Controller software installed, you will have to update it the next time you start the application.

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### *ZonePlayer(s) software updates*

If a ZonePlayer's software version gets out of sync from the rest of your Sonos Digital Music System components, you will see the following message displayed on your **Zones** menu:



*One or more ZonePlayers may need to be updated if you purchase a new ZonePlayer with a later software version, or if you plug in a ZonePlayer that was not in use when you performed your last software update.*

*You will also see this message if you have already updated your music system using the Controller. This message will indicate that the Desktop Controller software needs to be updated.*

Touch **OK** to begin the software update process.

Lambourne Dep. Ex. 1078 at 22-23.

280. Further, the source code reveals that this claim limitation is disclosed. **Zone Player** software, including the Linux kernel, runs on an SH4 processor. *See, e.g.:*

4. V1.2\v1.2-gold\mtools\buildscript, 45
5. V1.2\v1.2-gold\mtools\nightlylinuxbuild, 51, 63
6. V1.2\v1.2-gold\mtools\Makefile.rootfs, 11
7. V1.2\v1.2-gold\mtools\master.mk, 21, 42
8. V1.2\v1.2-gold\mtools\arch\sh4.mk, 1–9
9. V1.2\v1.2-gold\kernel\Makefile, 24
10. V1.2\v1.2-gold\kernel\sh4\sh4.config.ZP, 4, 21–59

281. I understand that Sonos does not dispute that the Sonos System discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over the Sonos System. I have reviewed Sonos's response ("Validity Contentions") as it relates to the Sonos System and Sonos

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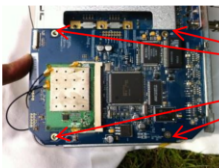
does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 85-86.

**5. Limitation 1.3: "a non-transitory computer-readable medium; and"**

282. In my opinion, the Sonos System discloses this claim limitation. As discussed with respect to Limitation 1.2 above, the Sonos System includes Zone Players that are digital and programmed with instructions that may be reprogrammed and updated. Accordingly, the Zone Players necessarily include a non-transitory computer-readable medium.

283. As shown in teardowns of the ZP100, the system includes a non-transitory computer-readable medium through nonvolatile memory on a motherboard.

## Network card



**1 – Remove the 4 top screws**



**2 – Unplug the power connector**

**3 – Unplug the ribbon connector (release by gently pulling the end clamp clips forward)**

[http://www.mediafire.com/file/0duavcuf1zyuc8u/sonos\\_dismantle.pdf/file?dkey=0duavcuf1zyuc8u;](http://www.mediafire.com/file/0duavcuf1zyuc8u/sonos_dismantle.pdf/file?dkey=0duavcuf1zyuc8u;) [https://en.community.sonos.com/advanced-setups-229000/sonos-zp100-dismantle-and-possible-repair-guide-35389.](https://en.community.sonos.com/advanced-setups-229000/sonos-zp100-dismantle-and-possible-repair-guide-35389)

284. Further, Sonos's documentation discloses that the software running on the ZP100 and Sonos's other prior art zone players could be reprogrammed or updated. Accordingly, that software is maintained on a non-transitory computer readable memory.

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## Getting Software Updates

Sonos periodically provides you with software updates to improve performance or to add new features. Your music system must be registered in order to receive updates.

There are two preference options available:

- Do not automatically check for updates. From the **Music** menu, you should periodically select **System Settings**→**Online Updates** to check for software updates.
  - Send a message when an update is available. (To change your preference setting, see "Auto check for software updates" on page 5-29.) The message, "Update Available" will appear on the **System Settings** menu next to **Online Updates** to indicate there are new Sonos updates available.
1. Touch **OK** to contact Sonos.
  2. If there is an update available, select **Yes** to begin the update process.

Your ZonePlayers and the Controller will be updated together as all Sonos components must carry the same software version number. This process may take several minutes per device, depending upon your network connection. Because this process can run unattended, Sonos recommends you start the update when you will be away from your Sonos Digital Music System for a period of time. If you have the Desktop Controller software installed, you will have to update it the next time you start the application.



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### ZonePlayer(s) software updates

If a ZonePlayer's software version gets out of sync from the rest of your Sonos Digital Music System components, you will see the following message displayed on your **Zones** menu:



*One or more ZonePlayers may need to be updated if you purchase a new ZonePlayer with a later software version, or if you plug in a ZonePlayer that was not in use when you performed your last software update.*

*You will also see this message if you have already updated your music system using the Controller. This message will indicate that the Desktop Controller software needs to be updated.*

Touch **OK** to begin the software update process.

Lambourne Dep. Ex. 1078 at 22-23.

285. Further, the source code reveals that this claim limitation is disclosed. **Zone Player software, including the Linux kernel and the main Zone Player application (anacpad), are stored in a cramfs filesystem on flash memory. See, e.g.:**

11. **motfiles target, V1.2\v1.2-gold\rootfs\Makefile, 24–29 at 26–27**
12. **motfiles-NOR target, V1.2\v1.2-gold\rootfs\Makefile.sub, 50–64**
13. **motfiles-NAND target, V1.2\v1.2-gold\rootfs\Makefile.sub, 66-80**
14. **install target, V1.2\v1.2-gold\rootfs\Makefile.sub, 82–98 at 84**
15. **\$(ARCH)/opt/bin/anacpad target, V1.2\v1.2-gold\rootfs\Makefile.sub, 240–312 at 257–261**
16. **root.cram.\$(ARCH).\$(RINCON\_VERSTRING), V1.2\v1.2-gold\rootfs\Makefile.sub, 622–633 at 630–631**
17. **V1.2\v1.2-gold\oc\zp\Makefile, 62–166**

286. I understand that Sonos does not dispute that the Sonos System discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's



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contentions for why Claim 1 of the '885 patent is not invalid over the Sonos System. I have reviewed Sonos's response ("Validity Contentions") as it relates to the Sonos System and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rqs) at 85-86.

**6. Limitation 1.4: "program instructions stored on the non-transitory computer-readable medium that, when executed by the one or more processors, cause the first zone player to perform functions comprising:"**

287. In my opinion, the Sonos System discloses this claim limitation. For the reasons stated above with respect to Limitations 1.2 and 1.3, the Zone Players in the Sonos System include program instructions stored on the non-transitory medium that when executed by the processors perform the functions discussed in the following claim limitations, as described below. The Zone Players may be programmed and updated, and once programmed and/or updated, the Zone Players execute the instructions that are stored on the Zone Player.

288. I understand that Sonos does not dispute that the Sonos System discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over the Sonos System. I have reviewed Sonos's response ("Validity Contentions") as it relates to the Sonos System and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rqs) at 85-86.

**7. Limitation 1.5: "while operating in a standalone mode in which the first zone player is configured to play back media individually in a**

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**networked media playback system comprising the first zone player and  
at least two other zone players:”**

289. In my opinion, the Sonos System discloses this claim limitation.

290. I note that Sonos has taken a position during its summary judgment briefing regarding what disclosure is adequate to disclose “standalone” mode.

First, a POSITA would understand that the claimed “standalone mode in which the first zone player is configured to play back media individually” refers to a “zone player” operating in a non-grouped state in which it is configured to play back audio on its own, rather than as part of a group for synchronous playback. See Ex. R, ¶53. As explained above, the ’885 Patent clearly discloses that “zone players” are capable of operating in such a “standalone mode.” *Supra* II.B.i.; ’885 Pat., 4:44-5:2, 5:21-6:27, 6:39-43; Ex. R, ¶39, 53.

That the ’885 specification does not use the term “standalone mode” verbatim does not mean that there is no written description support for that claim term. See *Novartis Pharms. Corp. v. Accord Healthcare, Inc.*, 21 F.4th 1362, 1370 (Fed. Cir. 2022).

Notably, although not relevant to whether there is written description support, Google appears to be improperly interpreting the claim term “standalone mode” to require that the “first zone player” be engaged in active playback. D.I. 249, 22. A “zone player” can be in “standalone mode” whether or not the “zone player” is engaging in active playback. Ex. R, ¶53 n5.

Dkt. 273-4 at 11.

291. As noted above, Sonos cites to the following sections of the ’885 patent to show that “standalone” mode is disclosed.

There are a number of multimedia players of which three examples 102, 104 and 106 are shown as audio devices. Each of the audio devices may be installed or provided in one particular area or zone and hence referred to as a zone player herein.

As used herein, unless explicitly stated otherwise, an audio source or audio sources are in digital format and can be transported or streamed over a data network.

’885 patent at 4:44-5:2.

Referring now to FIG. 2A, there is shown an exemplary functional block diagram of a zone player 200 in accordance with the present invention. The zone player 200 includes a network interface 202, a processor 204, a memory 206, an audio processing circuit 210, a module 212, and optionally, an audio amplifier 214 that may be internal or external. The network interface 202 facilitates a data flow between a data network (i.e., the data network 108 of FIG. 1) and the zone player 200 and typically executes a special set of rules (i.e., a

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protocol) to send data back and forth. One of the common protocols used in the Internet is TCP/IP (Transmission Control Protocol/Internet Protocol). In general, a network interface manages the assembling of an audio source or file into smaller packets that are transmitted over the data network or reassembles received packets into the original source or file. In addition, the network interface 202 handles the address part of each packet so that it gets to the right destination or intercepts packets destined for the zone player 200.

The network interface 202 may include one or both of a wireless interface 216 and a wired interface 217. The wireless interface 216, also referred to as a RF interface, provides network interface functions by a wireless means for the zone player 200 to communicate with other devices in accordance with a communication protocol (such as the wireless standard IEEE 802.11a, 802.11b or 802.11g). The wired interface 217 provides network interface functions by a wired means (e.g., an Ethernet cable). In one embodiment, a zone player includes both of the interfaces 216 and 217, and other zone players include only a RF or wired interface. Thus these other zone players communicate with other devices on a network or retrieve audio sources via the zone player. The processor 204 is configured to control the operation of other parts in the zone player 200. The memory 206 may be loaded with one or more software modules that can be executed by the processor 204 to achieve desired tasks. According to one aspect of the present invention, a software module implementing one embodiment of the present invention is executed, the processor 204 operates in accordance with the software module in reference to a saved zone group configuration characterizing a zone group created by a user, the zone player 200 is caused to retrieve an audio source from another zone player or a device on the network.

According to one embodiment of the present invention, the memory 206 is used to save one or more saved zone configuration files that may be retrieved for modification at any time. Typically, a saved zone group configuration file is transmitted to a controller (e.g., the controlling device 140 or 142 of FIG. 1, a computer, a portable device, or a TV) when a user operates the controlling device. The zone group configuration provides an interactive user interface so that various manipulations or control of the zone players may be performed.

The audio processing circuit 210 resembles most of the circuitry in an audio playback device and includes one or more digital-to-analog converters (DAC), an audio preprocessing part, an audio enhancement part or a digital signal processor and others. In operation, when an audio source is retrieved via the network interface 202, the audio source is processed in the audio processing circuit 210 to produce analog audio signals. The processed analog audio signals are then provided to the audio amplifier 214 for playback on speakers. In addition, the audio processing circuit 210 may include necessary circuitry to process analog signals as inputs to produce digital signals for sharing with other devices on a network.

Depending on an exact implementation, the module 212 may be implemented as a combination of hardware and software. In one embodiment, the module 212 is used to save a scene. The audio amplifier 214 is typically an analog circuit that powers the provided analog audio signals to drive one or more speakers.

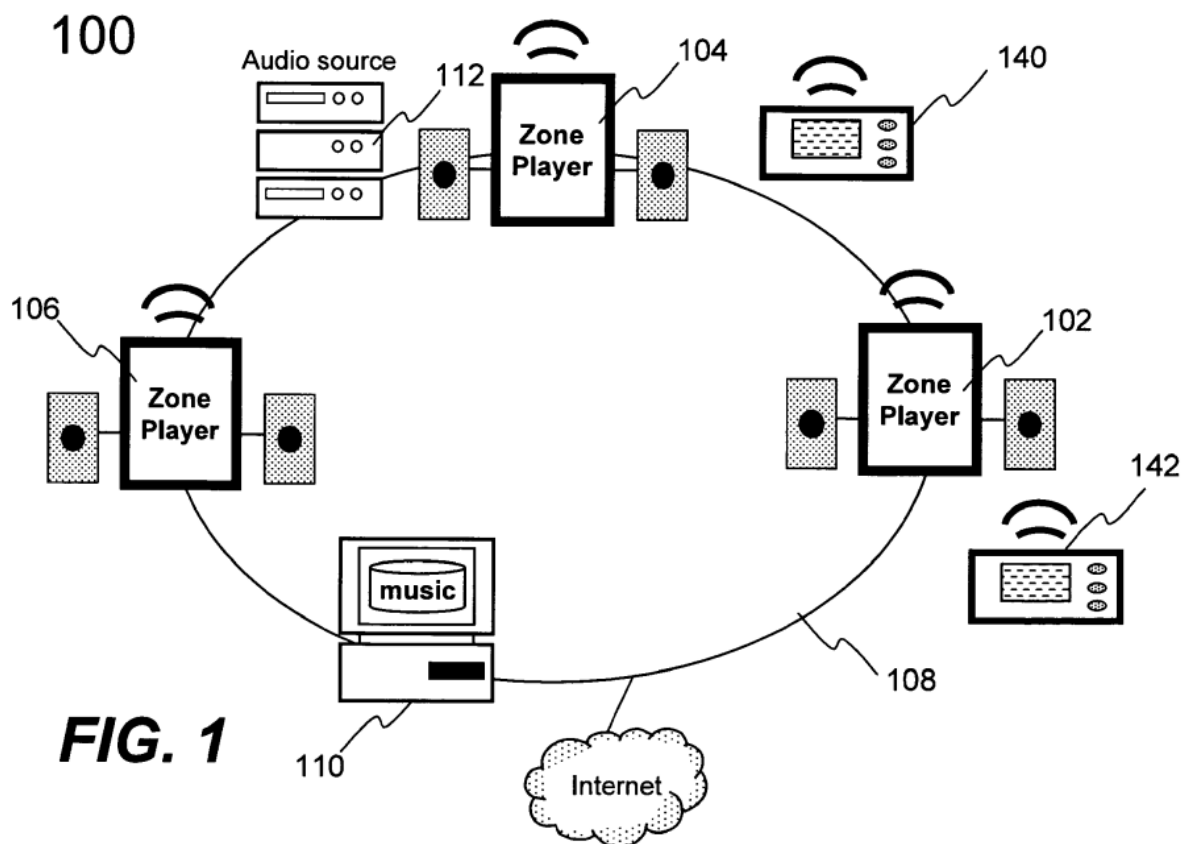
'885 patent at 5:21-6:27.

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When a particular audio source is being played in the zone player 200, a picture, if there is any, associated with the audio source may be transmitted from the zone player 200 to the controller 240 for display.

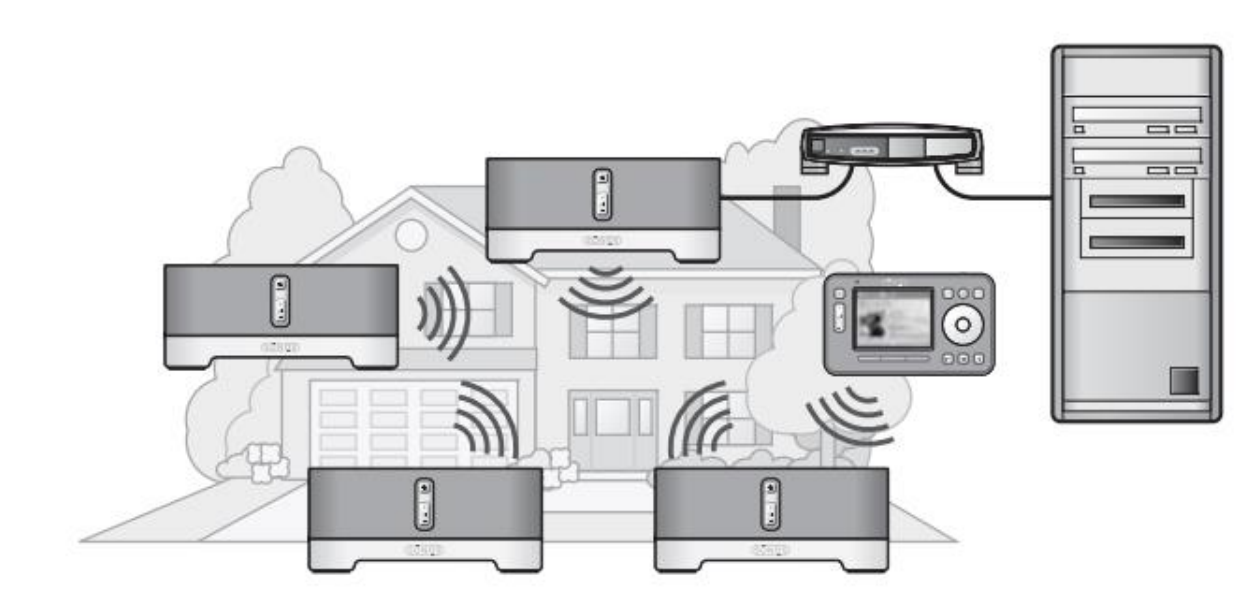
'885 patent at 6:39-43.

292. In the first portion of the specification cited above, Sonos appears to be arguing that “standalone” mode is disclosed through 102, 104, and 106 of the '885 patent, as shown in Figure 1 below:



293. A very similar image appears in the Sonos user manual showing the Zone Players (the ZP100s), just as they were identified in the specification above (102, 104, 106).

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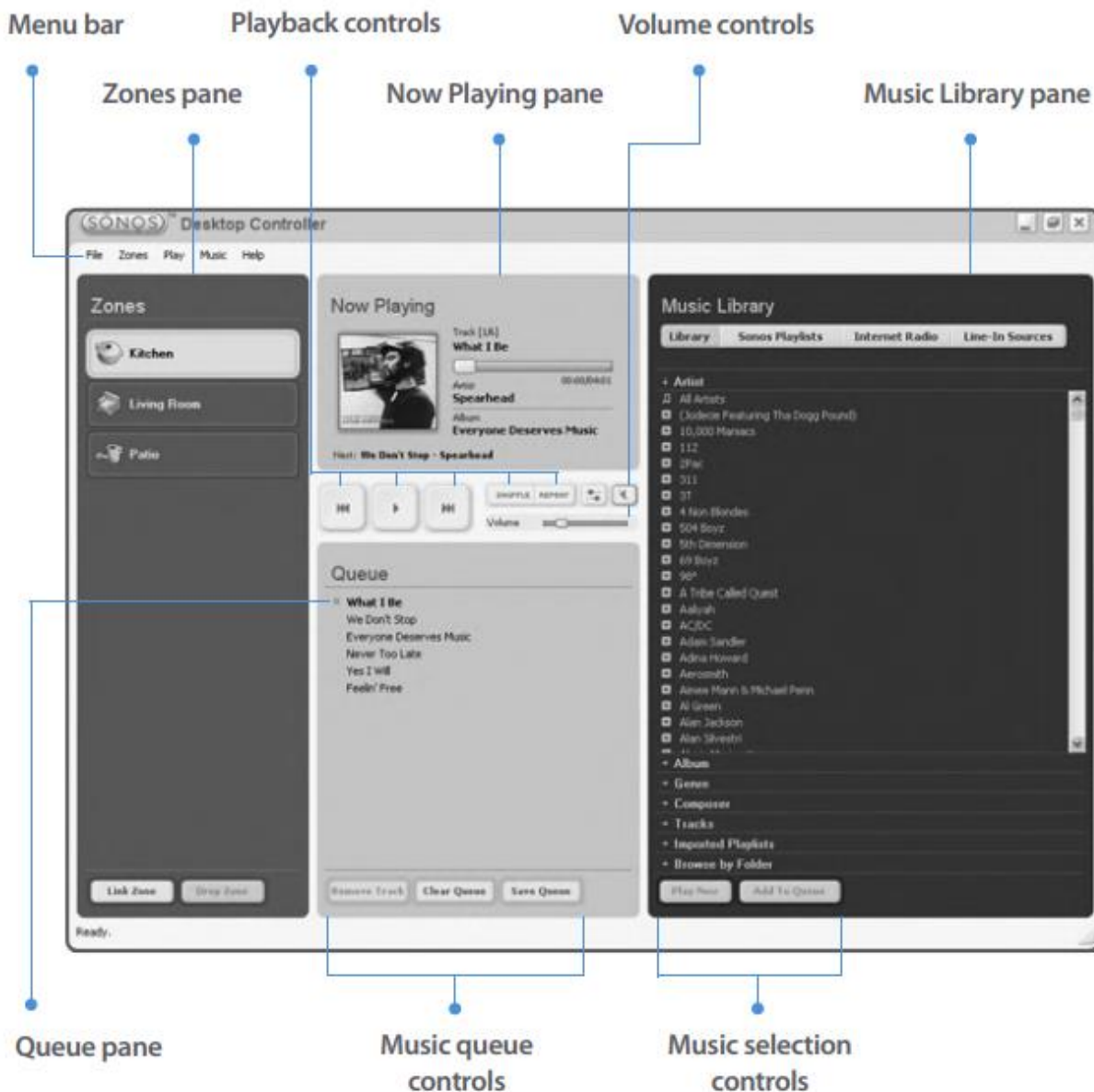


Lambourne Dep. Ex. 1077 at 6.

294. Sonos also argues that the mere ability of the Zone Player to output audio, as shown through 5:21-6:27, discloses the “standalone” mode. *E.g.*, ’885 patent at 5:21-6:27 (“when an audio source is retrieved via the network interface 202, the audio source is processed in the audio processing circuit 210 to produce analog audio signals. The processed analog audio signals are then provided to the audio amplifier 214 for playback on speakers.”). Zone Player 100 of the Sonos System likewise includes the same functionality, including the ability to select a Zone Player and play back audio to that Zone Player.

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## The Desktop Controller Main Menu



Lambourne Dep. Ex. 1077 at 25.

295. As Sonos argued in its MSJ briefing (quoted above), the fact that the Sonos documentation does not include the term “standalone mode” does not prevent it from disclosing “standalone mode.” Sonos further argued that “standalone mode” is disclosed by the ’885 patent regardless of whether the disclosed Zone Players are actively playing back music—in other words,

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just the fact that they exist and have the ability to play back music is sufficient. This is likewise disclosed by the Zone Players because they may or may not play back music, as shown above.

296. The source code reveals that this claim limitation is disclosed. The first Zone Player starts up as the group coordinator and channel source of a group for which it is the only member. See, e.g.:

297. modZPStartup(), V1.2\v1.2-gold\oc\zp\mod\_zp.cxx, 599–700 at 649–652

298. RZonePlayer constructor, V1.2\v1.2-gold\oc\zp\zp.cxx, 25–85 at 63, 67–68

299. RZonePlayer::m\_mediaRendererAVT (RAVTMediaRenderer), V1.2\v1.2-gold\oc\zp\zp.h, 254

300. RAVTMediaRenderer constructor, V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 29–51 at 42

301. RZonePlayer::m\_GM (RGMZonePlayer), V1.2\v1.2-gold\oc\zp\zp.h, 257

302. RGMZonePlayer constructor, V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 43–69 at 59–62

303. RGMZonePlayer::m\_rgGroupMembers (RGroupMember[]), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 154–155

304. RGroupMember constructor, V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 24–28

305. In addition to startup, the first Zone Player also becomes the group coordinator and channel source of a group for which it is the only member when dropped from a group. A controller, such as the Windows desktop controller, drops the first Zone Player from a group by sending a BecomeCoordinatorOfStandaloneGroup SOAP action to the first Zone Player's AVTransport control URI. Upon handling the BecomeCoordinatorOfStandaloneGroup SOAP action, the first Zone Player becomes the group coordinator and channel source of a standalone group (for which it is the only member). See, e.g.:

306. CRoomControl::OnZoneDrop(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 408–



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417 at 413–415

307. CJoinRoomsDlg::SetData(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 289–

294

308. CJoinRoomsDlg::Commit(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 107–

227 at 199, 211

309. CJoinRoomsDlg::RemoveZonePlayerFromGroup(), V1.2\v1.2-

gold\pc\pccp\join\_rooms\_dlg.cxx, 254–271 at 266

310. RAVTClient::BecomeCoordinatorOfStandaloneGroup(), V1.2\v1.2-

gold\oc\protocol\client\src\avt\_client.cxx, 218–224

311. BecomeCoordinatorOfStandaloneGroup action, V1.2\v1.2-

gold\cc\anacapa\anacapa\pkg\htdocs\xml\AVTransport1.xml, 567–575

312. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx,

39–83 at 47, 80

313. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

314. RAVTServer::BecomeCoordinatorOfStandaloneGroupWrapper(), V1.2\v1.2-

gold\oc\protocol\server\src\avt\_server.cxx, 457–473 at 465

315. RAVTMediaRenderer::BecomeCoordinatorOfStandaloneGroup(), V1.2\v1.2-

gold\oc\zp\avt\_impl.cxx, 555–613 at 555–561, 572–578, 592–593

316. RGMZonePlayer::localConfigureGroup(), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx,

460–590

317. The Sonos System supports households with multiple Zone Players. The first Zone Player tracks the device topology of discovered Zone Players in the same household, using a linked list data structure with no length limit. *See, e.g.:*

318. RZonePlayer::setup(), V1.2\v1.2-gold\oc\zp\zp.cxx, 243–362 at 286

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- 319. RZonePlayer::m\_devTopology (RDeviceTopology), V1.2\v1.2-gold\oc\zp\zp.h, 221–222
- 320. RDeviceTopology::setup(), V1.2\v1.2-gold\oc\zp\topology.cxx, 75–117 at 82–86, 111
- 321. modZPdisNotifyCallback(), V1.2\v1.2-gold\oc\zp\mod\_zp.c, 490–512 at 499–5
- 322. RDeviceTopology::discoveryNotify(), V1.2\v1.2-gold\oc\zp\topology.cxx, 461–500 at 485
- 323. RDeviceTopology::handleNewOrUpdatedZP(), V1.2\v1.2-gold\oc\zp\topology.cxx, 502–593 at 563–564
- 324. RDiscoveredZPs::getPopulatedRecord(), V1.2\v1.2-gold\oc\zp\topology.h, 195–205 at 201–203
- 325. RDiscoveredObjects::int\_getPopulatedRecord(), V1.2\v1.2-gold\oc\zp\topology.cxx, 2497–2513

326. Dr. Almeroth himself acknowledged that “[e]ach of the ‘zone players’ in the networked multi-zone audio system described in the ‘885 Patent (and in Sonos’s own system at the time)” (emphasis added) could “operate in one of two states at any given time,” including a “first state in which the ‘zone player’ is not actively grouped with any other ‘zone player’ but rather is configured to play back audio individually (i.e. a non-grouped or standalone mode).” Almeroth Rebuttal Report at 286. As I discuss further below, this two-phased process for grouping zone players, “whereby a user-created group is able to exist in an inactive state so that it can later be invoked” was anticipated and/or rendered obvious by the Sonos System. Almeroth Rebuttal Report at 290.

**(b) Obviousness – POSITA**

327. As an initial matter, I note that Dr. Almeroth claimed he had “not seen any evidence

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showing an apparent reason why a POSITA in 2005-06 would have been motivated to modify the ‘Sonos System’ reference and/or combine it with another reference in the various different ways proposed by Dr. Schonfeld in order achieve the claimed invention of the ‘885 Patent” and that he had “also seen other objective, real-world evidence demonstrating that a POSITA in 2005-06 would not have found the claim 1 of the ‘885 Patent to have been obvious, which stands in stark contrast to Dr. Schonfeld’s failure to support his obviousness opinions with any objective evidence.” Almeroth Rebuttal Report at 270. I understand that Dr. Almeroth also opined that the Sonos System “reference as well as all but one of the secondary references . . . were considered by U.S. Patent Office during prosecution,” and that Dr. Almeroth’s opinions are “further supported by [his] discussions with Nick Millington, . . . who confirmed that Sonos’s multi-room audio system as it existed in 2005-06 did not incorporate the ‘zone scene’ technology that is described and claimed in the ‘885 Patent.” Almeroth Rebuttal Report at 271-272. Simply because the USPTO cited certain references during prosecution does not mean that these references were considered - the USPTO did not rely on any of these references as the basis for its rejections. Additionally, the USPTO did not have the benefit of the Court’s claim construction for “zone scene.”

328. Nonetheless, as I discuss further below, there is evidence of why a POSITA in 2005-2006 would have been motivated to modify the Sonos System with other references. As Dr. Almeroth acknowledged, the Sonos System was released in January 2005 and allowed for a so-called “ad-hoc grouping process” which was time consuming. Almeroth Rebuttal Report at [285], [288]. Accordingly, at least as of January 2005, a POSITA using Sonos’s system would have been motivated to find an alternative to this time consuming grouping process, including pre-defined or saved groups (the claimed “zone scenes”). Indeed, Sonos users indicated as much on Sonos forums, and former Sonos employee Graham Farrar testified that Sonos employees themselves

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monitored these Sonos forums.

329. Additionally, as I addressed below in relation to Limitation 1.8, it would also have been obvious to modify the Sonos System in view of the knowledge of a POSITA to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.8.

**(c) Obviousness – Sonos Forums**

330. As I addressed below in relation to Limitation 1.6, it would also have been obvious to modify the Sonos System in view of Sonos Forums to add this claim limitation, to the extent it is not disclosed, for the same reasons discussed with respect to Limitation 1.6. Specifically, Sonos Forums were hosted by Sonos, for users of the Sonos system, and Sonos engineers reviewed and responded to a variety of Sonos forum posts. The Sonos forums, as described in Limitation 1.6 and Section X, disclose adding the ability to save and name “zone scenes,” which includes the ability to invoke separate “party modes” regardless of how the zone players within those party modes are operating (e.g., in standalone mode or in a grouped mode).

**(d) Obviousness – Nourse**

331. As I addressed below in relation to Limitation 1.6-1.8, it would also have been obvious to modify the Sonos System with Nourse to add this claim limitation, to the extent it is not disclosed, for the same reasons discussed with respect to Limitation 1.6-1.8.

**(e) Crestron**

332. As I addressed below in relation to Limitation 1.6, it would also have been obvious to modify the Sonos System with the Crestron system to add this claim limitation, to the extent it is not disclosed, for the same reasons discussed with respect to Limitation 1.6. The Crestron system, as described in Section X (and incorporated herein by reference), includes the ability to create zone groups while maintaining the ability to play to individual zones within those groups

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(e.g., in standalone mode).

8. **Limitation 1.6: “(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked; and”**

333. In my opinion, the Sonos System discloses this claim limitation.

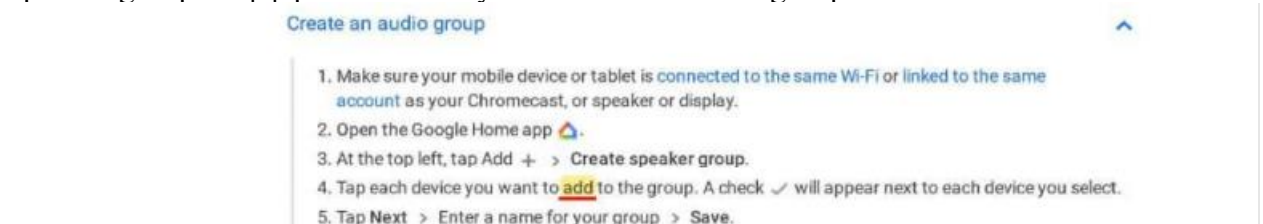
334. Sonos discussed this claim limitation, in part, in its summary judgment briefing.

*See* Dkt. 252-2. Sonos argued:

The evidence indisputably shows that (i) the process for creating a new Google speaker group involves a user selecting Accused Google Players to add to the speaker group via the Google Home app on the user’s controller device (the claimed “network device”), which then causes the user’s controller device to transmit a “join\_group” message to each Accused Google Player that was added to the speaker group via the Google Home app, and (ii) the “join\_group” message includes identifying information for the new speaker group. *See* D.I. 208, 4-7, 16-18. For instance, in its response to Sonos’s Interrogatory No. 13 (D.I. 208.03, Ex. B, 9), Google admitted:

“[A] user may select a specific device and add it to a group in [the Google] Home app, which causes the Google Home app to send a join\_group command to that device” and A “join\_group command” includes a “unique ID identifying the group” and a “name.” *See also* Ex. S (Mackay ITC Dep. Tr.), 112:2-5 (Google engineer testifying “the user selects a specific device and adds it to a group in [the] Home app, and that causes the Home [app] to send a join group command to that device.”).

Google’s website (D.I. 208-6, Ex. E, 7068) similarly instructs a user creating a speaker group to “[t]ap each device you want to add to the group”:



This evidence clearly establishes that each “join\_group” message is “a [] indication that the [Accused Google Player] has been added to a [] [speaker group]” at the claimed

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“network device.”

Faced with these admissions and other evidence of infringement, Google now tries to rewrite the “has been added” language of limitations 1.6 and 1.7 so that instead of requiring the “zone player” to receive “indications” that it “has been added” to “zone scenes” at the “network device” based on user input, it would require that the “first zone player” to receive indications that it has already previously “joined” itself to the “zone scenes.” See D.I. 249, 7-8. As such, Google is conflating the network device’s act of adding a “zone player” to a “zone scene” based on user input – which is what is claimed – with the zone player’s subsequent act of associating itself with (i.e., “joining”) a “zone scene.” And Google then relies on this rewrite to argue that because the “join\_group” messages do not indicate that an Accused Google Player has already previously “joined” itself to a speaker group, they do not amount to the claimed “indications.” *Id.* However, Google’s convoluted theory is based on an erroneous interpretation of the claimed “indication” that is contrary to the plain claim language and excludes the preferred embodiment in the ’885 Patent.

To start, the plain language of the “indication” limitations does not say anything about whether the “first zone player” has already “joined” itself to a “zone scene” before a claimed “indication” is received. Instead, the plain language describes the “first zone player” receiving, from a “network device,” an “indication” that the “first zone player” “has been added” to a “zone scene.” The claim’s use of the past-tense phrase “has been added” here when describing the “indication” that is received “from a network device” logically establishes that the claim is referring to some “add[]” action that previously took place at the “network device” prior to the “indication” being sent and received – namely, the action of adding a “zone player” to a “zone scene” at the “network device” based on user input – and not some prior “join” action that would have been taken by the “zone player” independent of the “network device,” as Google asserts. *See Ex. R, ¶22.*

Consistent with the logical reading of the claim language, the ’885 Patent only uses the term “add” or “added” in the context of the user interface for creating a zone scene and specifically the “add” actions that are carried out at the controller device (i.e., the claimed “network device”) in order to create the “zone scene” prior to it being saved. For instance, with respect to Figure 5A annotated here), the specification explains that a “user interface 500” on a controller can be used to create a “zone scene” by “add[ing]” or removing zone players from the zone scene via “Add/Remove buttons.” ’885 Pat., 5:19-20, Fig. 5A. The ’885 Patent also makes clear that the controller device’s action of adding zone players to a zone scene based on user input via the above “Add” button precedes and is distinct from the zone player’s action of associating itself with (i.e., joining) the zone scene, which cannot take place until after the zone player has been “added” to the zone scene at the controller device. *See Ex. R, ¶23.*

Relatedly, the ’885 Patent never once uses the term “add” or “added” to refer to the “zone player’s” action of associating itself (i.e., joining) with a “zone scene” that has previously been created at the user’s controller device, as Google’s interpretation would require. *Id.*, ¶24.



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This intrinsic evidence confirms that each of limitations 1.6-1.7 is referring to an “indication” that the “zone player” has been “added” to a “zone scene” at the “network device” based on user input – not that it has “joined” the “zone scene.” *Id.*, ¶25. And as established by the evidenced cited above, the accused “join\_group” messages indisputably satisfy these limitations.

Google also disputes that its “join\_group” messages amount to the claimed “indications” of limitations 1.6 and 1.7 based on the theory that each “indication” must include identifiers for the “zone players” that have been added to the “zone scenes” and that Google’s “join\_group” messages for new speaker groups do not include identifiers for the Accused Google Players that have been added to the new speaker groups. See D.I. 249, 9-11. Again, Google’s claim interpretation is flawed.

The particular claim language at issue is:

a [given] indication that the first zone player has been added to a [given] zone scene comprising a [given] predefined grouping of zone players including at least the first zone player and a [given other] zone player that are to be configured for synchronous playback of media when the [given] zone scene is invoked;

According to Google, the “comprising” phrase in the latter part of this clause modifies the term “indication” at the beginning of the clause such that it requires the “indication” itself to “comprise ‘at least the first zone player and a [given other] zone player’ – which Google then interprets to mean that the “indication” must include identifiers of the added “zone players.” *Id.*

Google’s interpretation is inconsistent with the plain language of the clause. As written, the “comprising” phrase clearly modifies the term “zone scene” that immediately precedes it, not the term “indication” that appears earlier in the clause. See Ex. R, ¶32. As such, the “comprising” phrase serves to define what the claimed “zone scene” is required to include – not what the claimed “indication” is required to indicate. *Id.* In this way, the “indication” must be an “indication that the first zone player has been added to [a given] zone scene” – nothing more is required by the “indication.” Separately, the “zone scene” to which the “zone player” has been added must comprise “[a] predefined grouping of zone players including at least the first zone player and [another] zone player,” but this is distinct from what the “indication” must indicate. Thus, there is no requirement that each claimed “indication” include identifiers of the added “zone players.” *Id.*

As explained above, each accused “join\_group” message comprising a “unique ID identifying the group” and “group name” does indicate that an Accused Google Player has been added to a particular speaker group, which is all that needed for infringement under the proper interpretation of each claimed “indication.” *Supra* II.A.ii; *see also* Ex. R, ¶26-29, 33.

*Id.* at 4-7.

335. Sonos therefore contends that adding a speaker to a speaker group via a controller

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and sending an “indication” that need not include the “zone scene” or the players in that zone scene is sufficient to meet this claim limitation. I also discussed the Court’s construction and ruling on “zone scene” above. *See* Section VIII.

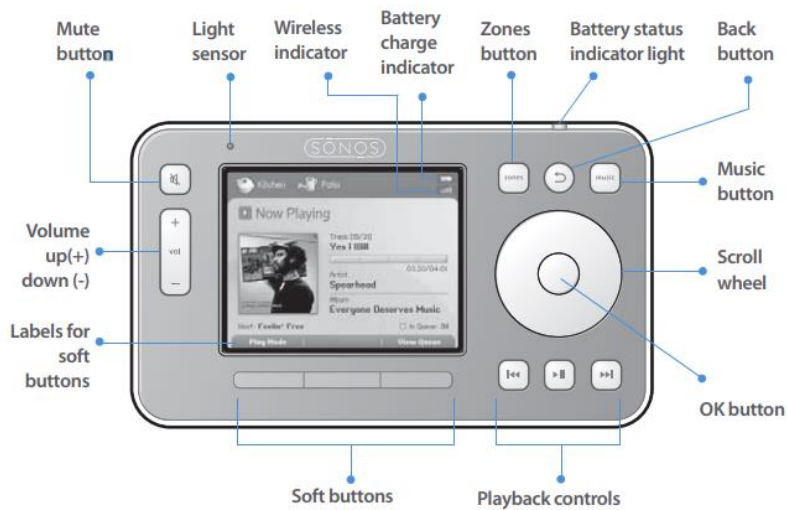
336. The Sonos System discloses this behavior. The claim limitation requires the Zone Player (previously identified as a ZP100 or other Zone Player on sale) to receive information from a network device over a data network. The network device may comprise the CR100 controller or the Mac or Windows desktop controller software, all of which allow a user to control Zone Players remotely over Wi-Fi or wired data networks. The Sonos System allows a Zone Player to receive a first indication in the form of network messages passed from the controller indicating that the Zone Player is to synchronously playback media with other Zone Players when the “zone scene” that those players were added to is invoked by selecting that “zone scene” for synchronous playback. The “zone scene” may be a group of speakers either defined by the user or predefined by the system, such as “Kitchen,” “Dining Room,” “Party Mode,” etc. “Kitchen,” “Dining Room,” “Party Mode,” etc. are all saved, named, and can be invoked - they meet the definition of a “zone scene.” Even if groups of speakers and/or Party Mode were not considered to be “zone scenes,” as I address below, it would have been obvious e.g., based on Sonos forums, to create “zone scenes,” which could be created, named and saved, and later invoked, at least because users of speaker systems were looking for convenient ways to save and invoke different speaker groups.

337. As Mr. Lambourne described, the CR100 controller or the desktop controllers for Mac or Windows could link and control the Zone Players. Lambourne Dep. Tr. at 67:17-25 (“The Party Mode that was originally put into the product was a button that would -- the control -- it was a button that appeared on the interface of a control device. Either a handheld control, we called it the CR 100, I think, at the time, or a desktop controller and pressing that button would group in that case all the speakers together so they would play music together in synchrony.”). The Sonos

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System user manual also describes using the CR100 controller as well as the Mac and Windows desktop controllers to send the claimed indication to the Zone Player. Images for the CR100 controller are shown below.

### Using the Controller



### Navigation



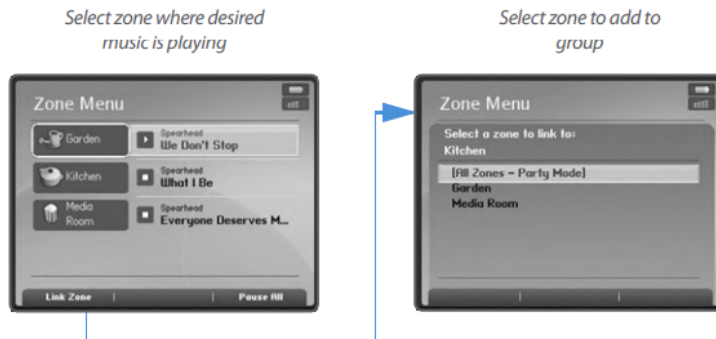
**Zones.** Use the **Zones** button to select a zone to play music in, or to view the music selections playing in each zone. You can also use this button to create or modify *zone groups* any time you want to share the same music across multiple zones.

Lambourne Dep. Ex. 1077 at 60.

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**To add a zone to a zone group**

1. Touch the **Zones** button on your Controller.



2. Highlight the zone or zone group you want to add a zone to, and touch **Link Zone**.

**Note:** The order in which you add a zone makes a difference. If you select **Link Zone** from a zone where there is no music playing, any zone you link to it will also be silent.

3. Highlight the zone you want to add to the group, and touch **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your ZonePlayers will then play the same music until you drop the zones from the zone group.



*Kitchen and Garden make up a zone group*

*The music queue from the added zone is automatically replaced by the music queue from the zone or zone group it was linked to so that both zones play the same music*

Lambourne Dep. Ex. 1078 at 4.

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**To drop a room from your zone group**

1. Touch the **Zones** button on your Controller.



2. Use the scroll wheel to highlight the zone group you want to change, and touch **Drop Zone**.
3. Highlight the zone you want to drop from the group, and touch **OK**. The room that's removed from the zone group stops playing music. The other zones in the zone group continue unaffected.

*Id.* at 5.

338. The Sonos System allows a user to add a speaker to a group and send an indication of that addition. A user may, for example, use the desktop controller software to “link” zone players together to create a “zone scene,” under Sonos’s understanding of that term.<sup>7</sup> Below, the example of “linking” the Kitchen Zone Player with the “Jack’s room” Zone Player is described. Another example of linking “Kitchen” with “[All Zones – Party Mode]” is also given.

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<sup>7</sup> Sonos has taken the following position regarding the meaning of “zone scene.” Sonos argues that “zone scene” means “a previously-saved grouping of zone players that are to be configured for synchronous playback of media when the zone scene is invoked.” Dkt. 273-4 (Sonos Reply ISO MSJ) at 1-3. Sonos has argued that merely “thematically” naming a previously saved group is sufficient to meet the definition of “zone scene.” Google has argued, on the other hand, that merely naming a speaker group is insufficient and that a common theme is required. I agree that Sonos’s claim construction of this term is flawed and that its position regarding “thematic” naming is ambiguous.

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**To link a zone to a zone group**

You can create a zone group first and then select music to play, or you can add a zone to a zone group where music is already playing.



**Note:** Any zones you link will automatically drop their current music queue and begin to play the music queue from the highlighted zone. You may sometimes want to save your music queue before linking a zone. See "To create a Sonos playlist" on page 3-17.

1. From the **Zones** pane, highlight the zone you want to link another zone or zone group to.
2. Choose one of the following options:
  - Click **Link Zone**.

Or,

- From the **Zones** menu, click **Link Zone**.



3. Select a zone to add to the group, and click **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your ZonePlayers will then play the same music until you drop the zones from the zone group.



**Note:** The order in which you add a zone makes a difference. If you select **Link Zone** from a zone where there is no music playing, any zone you link to it will also be silent.

Lambourne Dep. Ex. 1077 at 30; *see also* IA at 123, 125 (describing multi-room features).

339. The previously saved and named group, for example “Jack’s room + Kitchen” in the example below, can also be modified by removing Zone Players from the group, as shown below.



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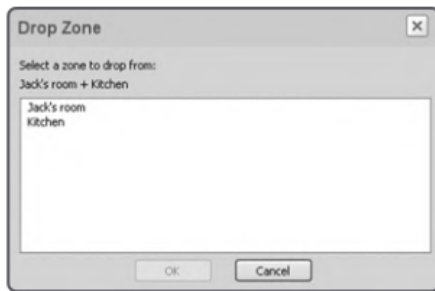
**To drop a zone from your zone group**

1. From the **Zones** pane, highlight the zone group you want to change.
2. Choose one of the following options:

- Click **Drop Zone**.

Or,

- From the **Zones** menu, click **Drop Zone**.



3. Select the zone you want to unlink from the group, and click **OK**.

The zone that's removed from the zone group stops playing music. The other rooms in the zone group continue unaffected.

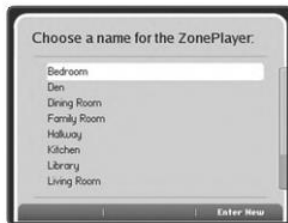
Lambourne Dep. Ex. 1077 at 31.

340. Zone Players and therefore groups of Zone Players may be named or renamed per the user's preference. Other groups such as "Party Mode" are preconfigured and also available to a user. The claims do not require the zone scenes to be "user selected." Predefined groups, such as the "party mode" in the Sonos System, therefore meet this claim limitation.

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### Renaming a ZonePlayer

1. From the **Music** menu, select **System Settings**→**Rename ZonePlayers** and touch **OK**.
2. Use the scroll wheel to highlight the ZonePlayer name you wish to change, and touch **OK**.
3. Use the scroll wheel to select a new name from the list, and then touch **OK**.



4. You can also type a unique name by selecting **Enter New**.



5. Use the scroll wheel to select each letter, touching **OK** after each entry.
6. Touch **Accept** to accept the new name, or touch **Cancel** to leave the screen without making a change.

Lambourne Dep. Ex. 1078 at 18.

341. I note that although dependent claim 7 of the '885 patent is not asserted, it informs the scope of independent claim 1. Dependent claim 7 of the '885 patent recites that “the first predefined grouping of zone players does not include the third zone player, and wherein the second predefined grouping of zone players does not include the second zone player,” effectively requiring that the first and second predefined groupings of zone players not be entirely overlapping, each with the same three zone players. Because claim 7 depends from claim 1 and must necessarily narrow the scope of claim 1, I understand that claim 1 includes first and second predefined groupings of zone players, where those groupings of zone players can wholly overlap. Indeed, such an overlap scenario would be consistent e.g., with a user having a user-created zone group including all three zone players, and having a “Party Mode,” i.e, a zone group including all

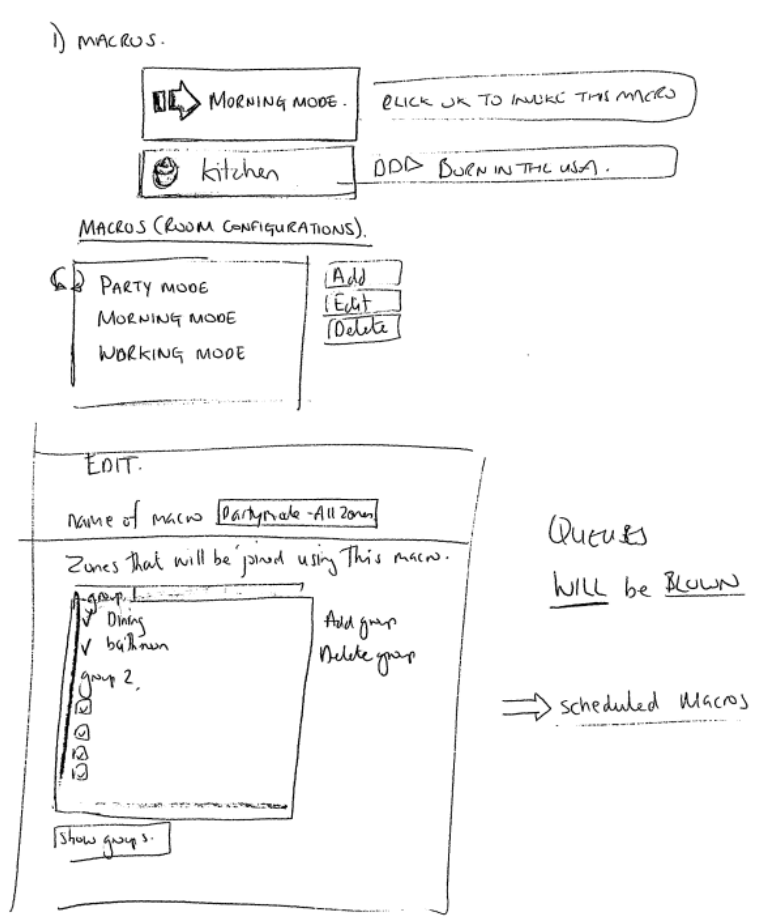
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three zone players.

342. Mr. Lambourne also testified that the Zone Player in the Sonos System would receive the claimed indication, stating that “the Party Mode in our original controller was a command sent by the control design that would tell the speakers in that moment to go for a group, and Party Mode was the term we gave to all the speakers together. This can be referring to that as saying okay, A and B are linked; C and D are linked; but Party Mode invokes them to join together. That could be coming from the control device and then he's describing how the end of Party Mode, A and B and C and D would stay together.” Lambourne Dep. Tr. at 79:2-12; 93:15-17 (“If Party Mode was -- if the user pressed Party Mode on the controller, then A, B and C would be caused to be grouped together.”); 118:24-119:4 (“Well, the wireless controller that we've been talking about earlier would be used to create that groups of -- I think you said A, B and C and D. So yeah, the wireless controller was being used to generate the command to make that group.”); 86:6-7 (“Yes. The Zone Players received commands from the CR 100.”); 187:17-21 (“That -- yes, that's one way that the user could get the -- get the rooms to all play the same music. They can also group the speakers, which is effectively the command that Party Mode sent to the player.”).

343. Sonos has also provided documentation showing that “zone scenes” were included in the Sonos System. For example, Mr. Lambourne testified that “party mode” was a “zone scene.” Lambourne Dep. Tr. at 63:8-13 (“Q. The Party Mode setting is a Zone Scene; right? THE WITNESS: Yeah. I think I describe a Party Mode as an example of a Zone Scene that can be set up, created.”) (objection omitted); 48:13-22 (“Q. Below the macros, in parenthesis, room configurations, there's a box with three entries. One says "party mode," one says "morning mode," and the final says "working mode." Do you see that? A Yes. Q. Were those examples of zone scenes? A Yes. Q. How do you know? A. Because I designed it.”).

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Lambourne Dep. Ex. 1097 at 42.

344. Sonos has also argued at times that a group must either be saved or named for a group to be considered a zone scene. As described above, however, groups that the user creates and groups that the Sonos System creates, such as Party Mode, are saved. A user can, for example, play to a particular group, pause or stop playback to that group, and restart or play new music to that group later. Party Mode is another group that is constantly accessible to the user. And a user may name Zone Players, which when grouped together take on a concatenated name. As such, a user can create a group with a particular name. Each of these features are discussed *supra* e.g., Section X.

345. Further, Sonos's own prior art system discloses "zone scenes" because it allowed a user to group zones together "with any other zone" to form a zone group. For example, as shown

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in the annotated images below, the user could link speakers to create a zone group (e.g., “Kitchen and Garden”) and could then play music synchronously throughout the group.

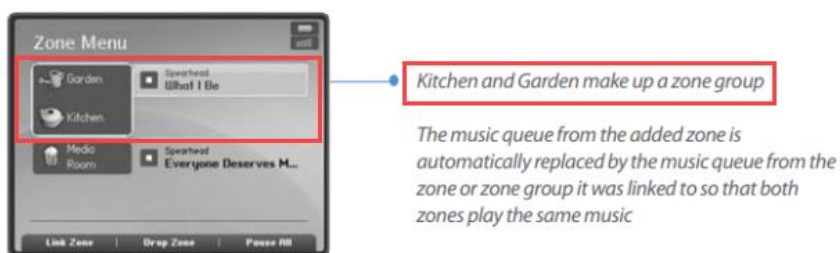
### Linking a zone

1. Press the **Zones** button on your Controller.



2. Highlight the zone or zone group that you want to add a zone to, and touch **Link Zone**.

3. Highlight the zone you want to add to the group, and touch **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your ZonePlayers will then play the same music until you drop the zones from the zone group.

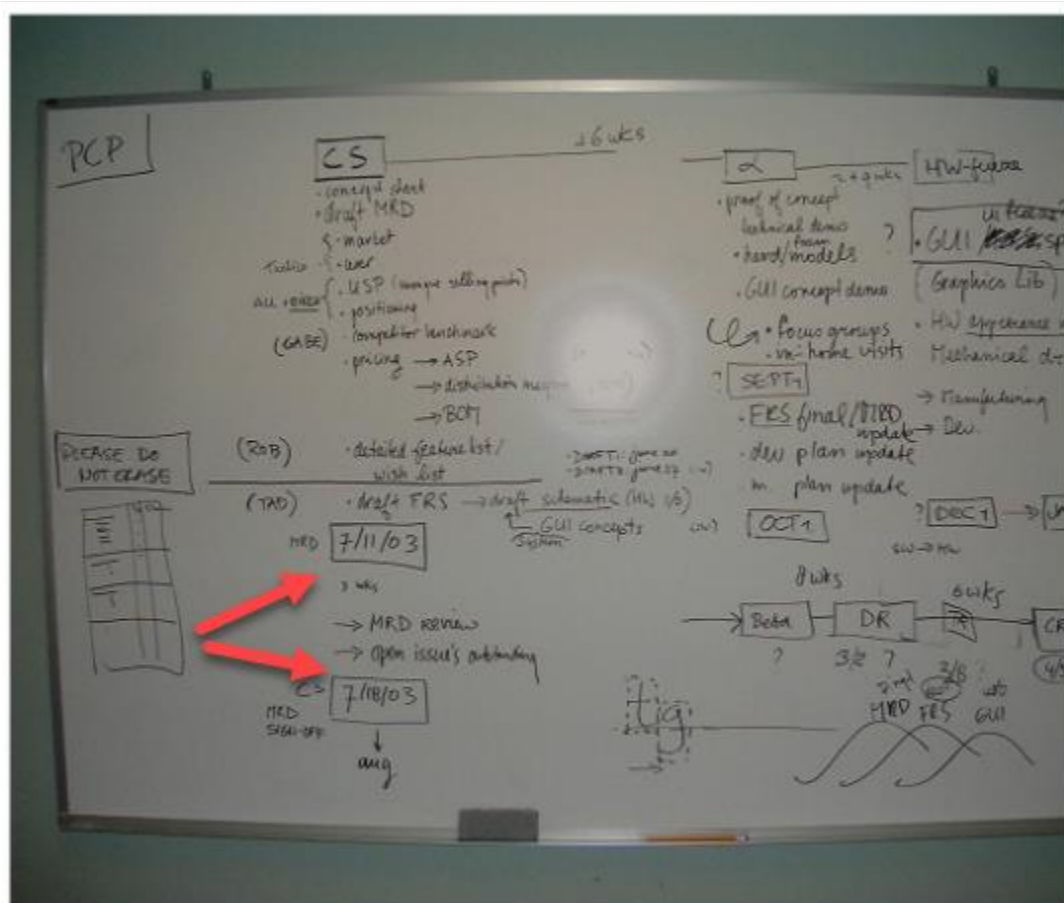


IA at 443; Lambourne Dep. Ex. 1078 at 2-4.<sup>8</sup>

346. This is confirmed by Sonos’s internal technical materials describing the Sonos System.

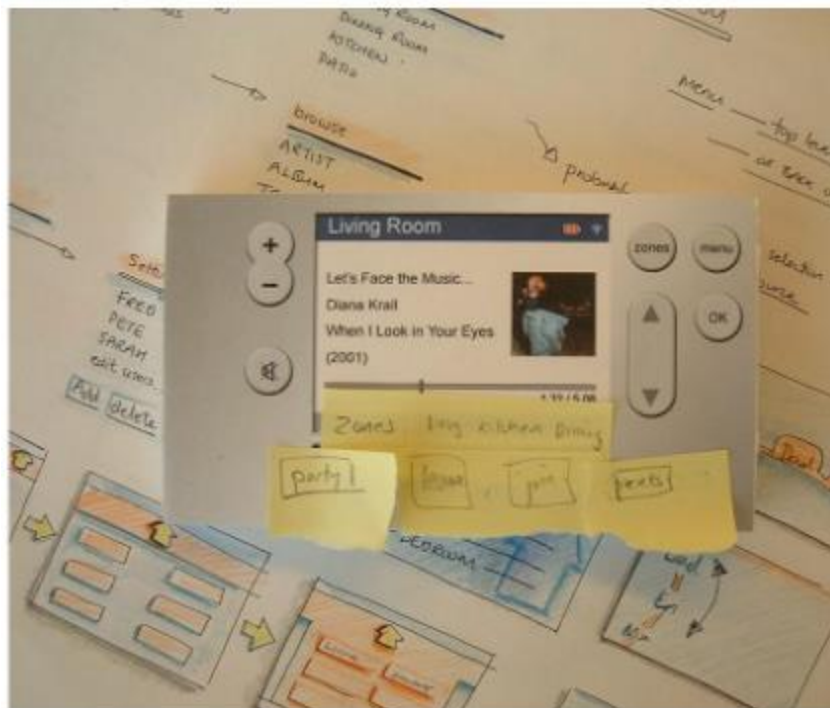
<sup>8</sup> I understand that Sonos recently produced a version of the April 2005 user manual. SONOS-SVG2-00227441 at -442. This produced version of the user manual appears identical to the version that I cite herein, and I hereby cross-reference this produced version for the same disclosures cited in my reports.

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SONOS-SVG2-00227363.

347. Sonos believed that the advances above were a distinction over prior art systems, and recognized that zone group creation was desirable and supported by the Sonos system.



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SONOS-SVG2-00227400.

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SONOS-SVG2-00227400; *see also id.* at -405 (February 2005), -406 (2004, February 2005); *see also* SONOS-SVG2-00227407 (October 2002 design document); *see also id.* at -410-413 (identifying standard hardware, software, and protocols used in development).

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Scenarios 9 July 03, Rob

A) Selecting music

- Select music from the music collections on the hard discs to play in the current zone.
- Select music from individual folders to play in the current zone.
- Select music the Rincon tuner to play in the current zone.
- Select a legacy source to play in the current zone.
- Select the music Rhapsody service and play a tune.

B) Zones

- Play the same music across all zones and then deal with different volumes in each zone.
- Stop the music from playing in one room, while retaining the music in the remainder of the rooms.
- Select a new album to play only in the living room.
- Move to the bedroom and choose different music to play there (while retaining the music in the living room).
- From the bedroom, stop the music in the living room.
- Go to the deck play the same music on the deck that is playing in the bedroom.
- Add the kitchen to the above music selection.

BACHELOR

Dave comes home from work, he wants to listen to music in his living room, He plonks down on the sofa and picks up the remote that he left there this morning. Immediately it comes to life and shows the same screen where he last used the remote before he went to work - playing national public radio through his Rincon tuner.

He uses the navigation buttons to select a favorite Miles Davis album and relaxes. After a while, he chooses to play something more upbeat as starts to get ready to go out. He navigates to play an Eminem album and then chooses to listen to the same song in all three zones of his house (living room, bedroom and kitchen). Thirty minutes later, just as he's leaving he picks up the remote and is able to stop the music in all zones at the same time.



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#### DINKS

Sarah is preparing for a party in the house. She's worked on a playlist for the occasion and starts it playing across all zones. Each zone needs to be set to a different volume but she's set the system to have default volumes in each room for party mode.

Later in the evening the guests are coming in from the patio, she decides to unhook the patio zone from the party mode so as not to disturb the neighbors. He does this effortlessly and without interrupting the music playback in the remainder of the house.

As the evening progresses, the playlist finishes and a guest is able to find some new music to play, without needing to understand zones.

#### FAMILY

Dad comes home from dropping the kids at their friend's house. He's got some time to do the bills. Picking up the remote, he wants to play music in the dining room. Mom is taking a nap in the bedroom. Earlier, the kids had been playing their Britney Spears album throughout the house at a high volume. Dad doesn't want to deal with the kid's music, so he selects himself as a user on the remote and is presented with just his music. He navigates to his favorite classical playlist to play in the living room at a lower volume and settles down to his bills. Later that afternoon, Dad wants the classical music to play in the den and the patio, so he adds these zones as the afternoon passes by. At this same time, mum has woken and, using their second remote, selects to play her Tony Bennett collection in the bedroom as she reads her book.

SONOS-SVG2-00227415; *see also* SONOS-SVG2-00227414 (email attaching document).

348. Commentators also recognized that being able to change room configuration “on the fly” was an important feature of the Sonos System.



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Even the price is reasonable, as long as you understand the audience that Sonos is chasing: Although the ZonePlayer is a digital audio hub, meaning that it plays MP3 and WMA files that reside on your PC, the system is really competing with whole-house audio systems based on CD changers and 12-channel audio amplifiers. Those can run to \$1,000 a room for dedicated wiring, an in-wall volume-control and remote-control sensor, and a whole-house amplifier. With the ZonePlayer, you buy one remote (\$399), and for each room where you want music, you buy one chunky, 10-pound hub (\$499 each, or \$1,199 for two hubs plus a remote).

Unlike other digital audio hubs, which typically cost \$100 to \$200 and don't look half as striking, the ZonePlayer integrates a 50-watt-per-channel stereo amplifier. That means you can use traditional audio speakers without the need to hook the system to your existing stereo. While most users will choose to use that built-in amplifier, there is a line-level output to use with powered speakers or an external amp.

And not only does ZonePlayer have an Ethernet jack, it also has a four-port 10/100-Mbps switch, as well as proprietary (not 802.11b) wireless. Only the first ZonePlayer you install has to be wired. A 2.4-GHz peer-to-peer mesh network passes the audio along



**THE ZONEPLAYER ZP100** is as elegant as it is simple to set up. The remote has a large color screen for accessing your music.

the ZonePlayer can see network drives directly, not just as mapped drives of desktop PCs. Song information is stored on each ZonePlayer.

Most users love the idea of multiple independent streams of music: rock in the rec room, classical in the kitchen, and jazz on the patio, all simultaneously. That's something most other hubs can do. But the ZonePlayer does the opposite as well: It can play the same music throughout the house, perfectly synchronized. Even though that may seem drop-dead simple, other hubs don't do it. And you can join multiple rooms to play the same music or put something different on in other rooms on the fly.

You can also play Internet radio: The ZonePlayer supplies a sampling of about 70 stations,

As you might expect from a remote control that costs as much as a PDA, this one is a gem. It integrates a 3.5-inch backlit color display and 13 buttons. You move through lists by sliding your finger along a circular scroll wheel, then pressing a Select button in the center. On the LCD, you see album art, the name of the song playing, the artist, the album, the elapsed/total playing time, the next song up, and the remaining songs in the queue for each room (or zone).

If you want to crank up ZZ Top in your downstairs office, it takes just a couple of seconds to tap the Zones button and drop the music link to the living room. Want less volume for background music in the living room than in the kitchen? Press the volume-down button, then slide the

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SONOS-SVG2-00227422.

## Gadget That 'Streams' Music Around House Is Terrific but Pricey

By

Walter S. Mossberg Staff Reporter of The Wall Street Journal

Updated Feb. 24, 2005 11:59 p.m. ET

group the "Zones," so several receive the same music simultaneously. And you can mute or pause all the players in a house at once.

The system also can play back music from Internet radio stations. And you can plug any outside music source, like an iPod, into any one of the ZonePlayers and hear its music throughout the system.

Next month Sonos plans to add another function to the product: the ability to receive streaming music from [RealNetworks'](#) Rhapsody online subscription music service.

SONOS-SVG2-00227427.

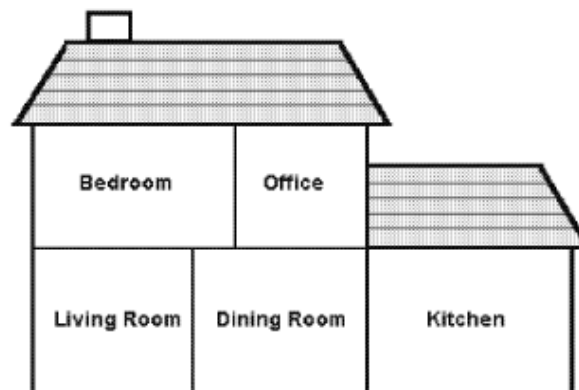
### Important user tasks

Rob Lambourne, 8 August 2003

The following describes a set of user tasks that our users should be able to manage easily using the remote.

#### Starting Scenario:

A house with 5 zone players in 5 rooms: Living Room, Dining Room, Master Bedroom, Kitchen and Office.



Start point all 5 zones are separated (not linked in any way). One zone – the office is playing music.

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### **Zone linking**

Link/synchronize the music that is playing across zones

Possible scenarios for doing this

1. You are in the Living Room listening to music. You want to play that same music in the office and Kitchen.
2. You are in the bedroom listening to nothing. You want to listen to the same music that is playing in the office.
3. You are getting ready for a party and want to make every room except the bedroom play the same music.

From the room groupings above – be able change the volume in each room separately.

From the groupings above, be able to separate one room from the rooms that have been linked together, and then find some new music for that room to play.

SONOS-SVG2-00227437.

349. The user could also name individual speakers (zone players), in turn naming the zone groups. For example, below, “linking” the “Kitchen” Zone Player with the “Jack’s room” Zone Player is shown, and the resulting group is named “Jack’s Room+Kitchen.” The previously-saved and named group, for example “Jack’s room + Kitchen” in the example below, can also be modified by removing Zone Players from the group, as shown below.



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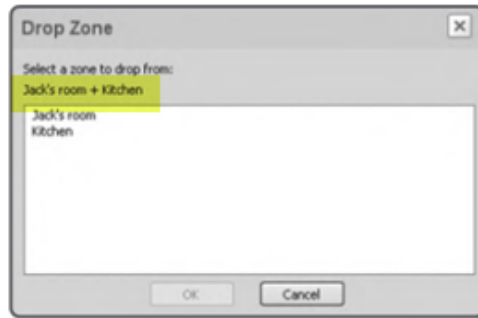
### To drop a zone from your zone group

1. From the **Zones** pane, highlight the zone group you want to change.
2. Choose one of the following options:

- Click **Drop Zone**.

Or,

- From the **Zones** menu, click **Drop Zone**.



3. Select the zone you want to unlink from the group, and click **OK**.

The zone that's removed from the zone group stops playing music. The other rooms in the zone group continue unaffected.

Lambourne Dep. Ex. 1077 at 31.

350. Zone Players and therefore groups of Zone Players may be named or renamed in accordance with the user's preference, including, for example, "Morning" or other "common themes" addressed by the Court's Order. For example, a user could name the Zone Players, to be joined in a zone scene, "Morning" and "Theme"—creating the zone scene "Morning + Theme." And while a user may potentially name the zone scene with a "non-thematic" name, the Court has held that the capability to so name the zone scene is sufficient to meet the language of the claim.

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### Renaming a ZonePlayer

1. From the **Music** menu, select **System Settings**→**Rename ZonePlayers** and touch **OK**.
2. Use the scroll wheel to highlight the ZonePlayer name you wish to change, and touch **OK**.
3. Use the scroll wheel to select a new name from the list, and then touch **OK**.



4. You can also type a unique name by selecting **Enter New**.



5. Use the scroll wheel to select each letter, touching **OK** after each entry.
6. Touch **Accept** to accept the new name, or touch **Cancel** to leave the screen without making a change.

Lambourne Dep. Ex. 1078 at 18.

351. Other groups such as “Party Mode” are preconfigured and also available to the user. Another example of linking the “Kitchen” Zone Player with “[All Zones – Party Mode]” is illustrated below.

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### To link a zone to a zone group

You can create a zone group first and then select music to play, or you can add a zone to a zone group where music is already playing.



**Note:** Any zones you link will automatically drop their current music queue and begin to play the music queue from the highlighted zone. You may sometimes want to save your music queue before linking a zone. See "To create a Sonos playlist" on page 3-17.

1. From the **Zones** pane, highlight the zone you want to link another zone or zone group to.
  2. Choose one of the following options:
    - Click **Link Zone**.
- Or,
- From the **Zones** menu, click **Link Zone**.



3. Select a zone to add to the group, and click **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your ZonePlayers will then play the same music until you drop the zones from the zone group.



**Note:** The order in which you add a zone makes a difference. If you select **Link Zone** from a zone where there is no music playing, any zone you link to it will also be silent.

Lambourne Dep. Ex. 1077 at 30; *see also* IA at 123, 125 (describing multi-room features).

352. Under the Court's Order, "Party Mode" is a speaker group with a thematic name, which satisfies the claim "zone scene" elements under the Court's Order.

353. Further, a controller, such as the Windows desktop controller, provides a user interface to add Zone Players from a "joiner" group to a "joiner" group. The controller adds the first Zone Player to a first joiner group by sending a SetAVTransportURI SOAP action, with the first joiner group's Now Playing URI, to the first Zone Player's AVTransport control URI. The

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Now Playing URI has the form “x-rincon:<GROUP COORDINATOR UUID>,” which embeds a UUID identifying the Zone Player that is the group coordinator for the first joiner group. The first joiner group includes a second Zone Player. *See, e.g.:*

18. CRoomControl::OnZoneAdd(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 389–406 at 394–396

19. CJoinRoomsDlg::SetData(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 289–294

20. CJoinRoomsDlg::Commit(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 107–227 at 123–125, 152, 158

21. PCUtils::NowPlayingUriFromUDN(), V1.2\v1.2-gold\pc\pccp\pc\_utils.h, 61–65 at 63–64

22. RAVTClient::SetAVTransportURI(), V1.2\v1.2-gold\oc\protocol\client\src\avt\_client.cxx, 19–28

23. AVTransportURI action V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\AVTransport1.xml, 238–254

354. The first Zone Player receives a SetAVTransportURI SOAP action with a Rincon group URI that identifies the group to join (joiner group). The Rincon Group URI is the Now Playing URI that was sent by the controller. The Rincon Group URI has the form “x-rincon:<GROUP COORDINATOR UUID>,” which embeds a UUID identifying the Zone Player that is the group coordinator for the joined group.

355. The first Zone Player handles the SetAVTransportURI SOAP action by extracting the group coordinator’s UUID from the URI, stopping the local channel sink, using the group coordinator’s UUID to determine the Group Management control URI, requesting the group coordinator via the Group Management control URI to add the first Zone Player to its group, and setting up the local channel sink to listen to and play the group coordinator’s channel source. The first Zone Player sends the AddMember SOAP action to the group coordinator’s GroupManagement service to request addition to the group. *See, e.g.,*



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24. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 39–83 at 66, 80

25. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

26. RAVTServer::SetAVTransportURIWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 85–106 at 96–98

27. RAVTMediaRenderer::SetAVTransportURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 58–136 at 87–89

28. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 423–492 at 428–430, 440, 443–447, 460–466

29. RGMZonePlayer::localConfigureGroup(), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 460–590 at 525–526, 529, 532–536

30. RDeviceTopology::getGMControlURIFromRemoteUUID(), V1.2\v1.2-gold\oc\zp\topology.cxx, 1067–1089

31. RGMClient::AddMember(), V1.2\v1.2-gold\oc\protocol\client\src\gm\_client.cxx, 19–32

32. AddMember action, V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\GroupManagement1.xml, 26–45

356. The group coordinator handles the AddMember SOAP action by storing the new group member, including adding the new group member to a collection of group members maintained by the group coordinator's GroupManagement (GM) service component. *See, e.g.:*

33. modZPUPnPControl(), V1.2\v1.2-gold\oc\zp\mod\_zp.cxx, 728–732 at 731

34. RZonePlayer::dispatchUPnPControl(), V1.2\v1.2-gold\oc\zp\zp.cxx, 411–458 at 455

35. RGMServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\gm\_server.cxx, 37–60 at 45, 57

36. dm2(), V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

37. RGMServer::AddMemberWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\gm\_server.cxx, 62–88 at 72–76

38. RGMZonePlayer::AddMember(), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 82–139 at 104–112

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39. RGMZonePlayer::m\_rgGroupMembers[], V1.2\ v1.2-gold\oc\zp\gm\_impl.h, 154–155

357. As part of setting up the local channel sink to listen to and play the group coordinator's channel source, the Zone Player switches to the channel source as the Simple Network Time Protocol (SNTP) server for playback time monitoring. During playback, the channel sink uses the SNTP server to determine the clock offset from the server. The clock offset is used to adjust the actual play time. The channel sink also adjusts the digital-to-analog converter (DAC) clock speed to compensate for differences between the desired and actual play times. *See, e.g.:*

40. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\ v1.2-gold\oc\zp\avt\_impl.cxx, 423–492 at 466

41. RChannelSink::changeToRemoteSourceAndPlay(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 309–337 at 315–318

42. RChannelSink::setRemoteTransportSettings(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 663–695 at 679–680, 683–687, 689, 692

43. RChannelSourceTransportSettings::transportSettings(), V1.2\ v1.2-gold\oc\zp\srcbase.h, 47–56

44. RChannelSink::m\_SNTP, V1.2\ v1.2-gold\oc\zp\chsnk.h, 102–104

45. RChannelSink::notifySamples(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 809–902 at 880–895

46. SNTPPollThread::convertServerTimeToLocalTime(), V1.2\ v1.2-gold\oc\zp\snthpoll.cxx, 180–193

47. RChannelSink::monitorDACClock(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 965–1016

48. RChannelSourceBase constructor, V1.2\ v1.2-gold\oc\zp\srcbase.cxx, 102–157

49. SNTPServerThread::threadFuncInternal(), V1.2\ v1.2-gold\oc\zp\snthpsrv.cxx, 37–65 at 60

50. handleSntpRequest(), V1.2\ v1.2-gold\oc\zp\snth.cxx, 336–366

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**(b) Obviousness – POSITA**

358. As Dr. Almeroth acknowledged, the Sonos System was released in January 2005 and allowed for a so-called “ad-hoc grouping process” which was time consuming. Almeroth Rebuttal Report at [285], [288]. Accordingly, at least as of January 2005, a POSITA using Sonos’s system would have been motivated to find an alternative to this time consuming grouping process, including pre-defined or saved groups (the claimed “zone scenes”). Indeed, Sonos users indicated as much on Sonos forums, and former Sonos employee Graham Farrar testified that Sonos employees themselves monitored these Sonos forums.

359. Additionally, as I addressed below in relation to Limitation 1.8, it would also have been obvious to modify the Sonos System in view of the knowledge of a POSITA to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.8.

**(c) Obviousness – Sonos Forums**

360. It would also have been obvious to modify the Sonos System with Sonos Forums to add this claim limitation, to the extent it is not disclosed. For example, the Sonos Forums described *supra* (and fully incorporated herein by reference), disclose the “macro” / “zone scene” Sonos allegedly invented.<sup>9</sup>

**Macro / presets**

16 years ago • 61 replies

JeffT

Just got the intro bundle, and I am impressed. I did a search and did not find this suggested, but I would save Zone links as favorites. With only 2 ZPs it is not a problem yet, but when I add more it maybe. I would like to setup say Morning mode for the units I want in the morning and a preset volume between the units. Another example I would have 2 party modes, Summer and Winter. The Summer mode would include the deck speakers and the Winter mode would not. Also it would be nice to have playlists or radio station associated with each mode. So when I get up I press Morning the DI Chill radio station plays.

Jeff


<sup>9</sup> I hereby incorporate by reference the opinions I expressed during my deposition regarding the Sonos Forums. *See* Schonfeld Dep. Tr., e.g. at pp 188-196.

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Farrar Dep. Ex. 6 at 1.

**Virtual Zones and Zone Grouping**

17 years ago • 190 replies




 theboyg

This "link/unlink" business is really cumbersome - and not a joy to use which goes against the ease of use of the rest of the system.

Why can't I have a virtual zone - ie a zone called "Downstairs" - and I can group all my downstairs zones into this. Then I don't have to keep manually linking/unlinking multiple zones everytime.

PLEASE !

G.

 2 people like this  **Exhibit  
0008**

Farrar Dep. Ex. 8 at 1.

361. As Mr. Lambourne testified, the users requesting “virtual zones” and “macro” or “preset” groups disclosed the “zone scene” concept. Lambourne Dep. Tr. at 131 (“Q. Did your invention address the concerns of these users through adding Zone Scenes? THE WITNESS: Yes. My invention would describe the need described here. Q. Why is that? A. By allowing a user to save zone groupings or linking, as being referred to here.”) (objections omitted). The named and saved groups also meet Sonos’s requirements that for a group to be a “zone scene” that it must be named and saved. The “virtual zones” and “macros” save the groups, as shown in those Forum posts, and the users are attributing names to them like “Downstairs.”

362. Sonos Forums demonstrates, among other things, the knowledge of persons of skill in the art and even Sonos’s ordinary users at the time of the alleged invention. As discussed below, those ordinary users were well aware that overlapping speaker groups could be named and saved, and that this would have been an obvious addition to the Sonos System, with obvious advantages identified by those users.

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363. For example, the Sonos Forum post authored by “JeffT,” reproduced below, references a user “set[ting]up say Morning mode,” and two different “party modes, Summer and Winter,” which overlapped because “[t]he Summer mode would include the deck speakers and the Winter mode would not.” The post also discloses these “modes” being saved, because the user could “when I get up ... press Morning” to play a certain radio station. As the Court’s Order clarified, the type of zone groups described in the Sonos Forums are zone scenes, because the user may name and save those zone groups for future use. The user even gave the zone scenes “thematic” names recognized by the Court such as “Morning” and further zone scenes called “Summer” and “Winter,” which would include or not include (respectively) all zones and all zones except the deck. Further, although the Court held that it was not necessary, the zone scenes disclosed in the Sonos Forums include attributes such as particular radio stations associated with those zone scenes.

### Macro / presets

16 years ago • 61 replies

 JeffT

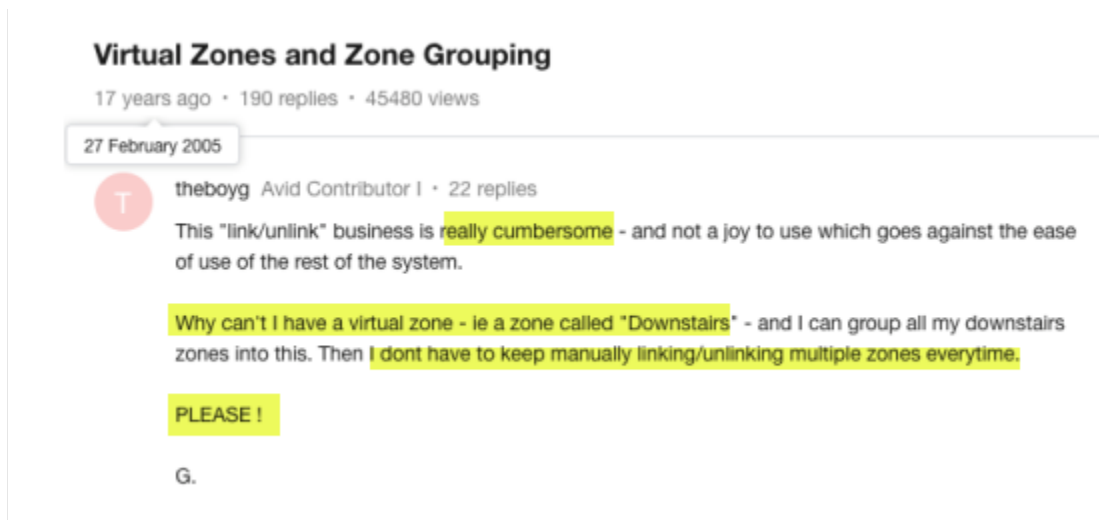
Just got the intro bundle, and I am impressed. I did a search and did not find this suggested, but I would save Zone links as favorites. With only 2 ZPs it is not a problem yet, but when I add more it maybe. I would like to setup say Morning mode for the units I want in the morning and a preset volume between the units. Another example I would have 2 party modes, Summer and Winter. The Summer mode would include the deck speakers and the Winter mode would not. Also it would be nice to have playlists or radio station associated with each mode. So when I get up I press Morning the DI Chill radio station plays.

Jeff

364. As another example, the Sonos Forum post by “theboyg” on February 27, 2005, annotated and reproduced below, also rendered obvious a user creating, naming, and saving a “virtual zone – ie a zone called ‘Downstairs.’” As “theboyg” pointed out, this new virtual zone would avoid having to “keep manually linking/unlinking multiple zones everytime.” As the

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Court’s Order indicated, “The specification further clarifies that zone players can be played ‘synchronously if the players are grouped together,’ or ‘individually if the players are disassociated with each other’ (*see* ’885 patent at 3:26–31; *see also* 9:16–20; 10:53–63),” and the Forum post by “theboyg” discloses the same. The Court’s Order clarified that a zone scene may be saved—alleviating the need for a user to “keep manually linking/unlinking multiple zones everytime”—and named like “Downstairs.” Indeed, the group name “Downstairs” was also used by Dr. Almeroth to describe a “zone scene.” *E.g.*, Almeroth Rep. ¶¶974, 979, 1014.



365. The Sonos Forums were moderated by Sonos, and on these Forums, Sonos users posted about Sonos products. Some of Sonos’s employees (*e.g.*, Graham Farrar) participated in these Forums and reviewed users’ posts and their feedback, and even Sonos’s product management teams were aware of the Forum posts and feature suggestions. *See, e.g.*, Graham Farrar Dep. Tr. at 50:13-51:4, 94:14-21. Accordingly, a person of ordinary skill in the art familiar with the Sonos System would have also been familiar with the Sonos Forums.

366. To the extent it is found that the Sonos 2005 System did not explicitly disclose a “zone scene” as discussed in the Court’s Order, such features would have been obvious to a person of skill in the art, in view at least of the Sonos Forums.

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**(d) Obviousness – Nourse**

367. To the extent it is found that the Sonos 2005 system did not explicitly disclose a “zone scene” as discussed in the Court’s Order, such features would have been obvious to a person of skill in the art, in view at least of the Sonos Forums, and/or U.S. Patent No. 7,197,148 (“Nourse”). Nourse discloses a conventional “centralized speaker system that allows multiple speakers connected to a centralized amplifier speaker line to be monitored and controlled from a central location via a master/slave protocol.” Nourse at Abstract; *see also, e.g., id.* at 2:18-20 (“In accordance with the present invention, a speaker system is provided having distributed speakers and amplifiers and centralized speaker monitoring and command control.”), FIG. 1.

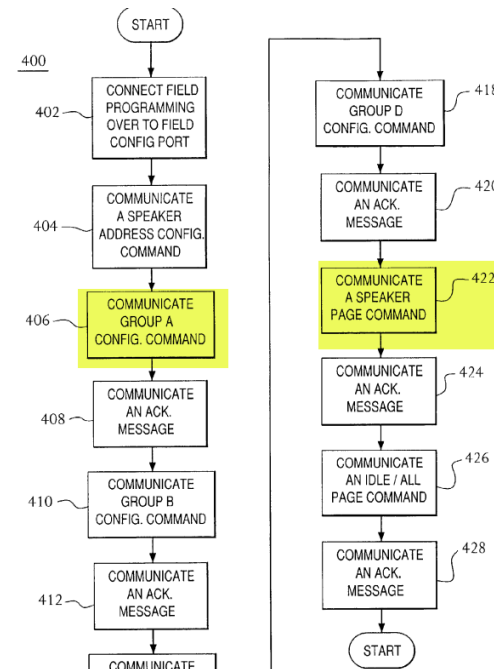
368. Nourse discloses the ability to create and save “zone scenes” as described by the Court, including choosing group members from any of the available speakers (including speakers within previously-saved and named groups—*i.e.*, zone scenes). *See, e.g.*, Nourse at 3:57:60 (“Each of the plurality of speakers 152 preferably has a unique 16-bit address. Each of the plurality of speakers 152 can further be assigned up to four group identifiers (IDS).”), 4:4-5 (“first speaker 152, can be assigned to more than one group”), 4:11-13 (“up to 16 master controls units 102 can be controlled individually and/or simultaneously via the computer 154 using the master control unit 102 addresses.”). A person of skill in the art at the time of the alleged invention working with the Sonos 2005 System would have found it obvious to look to other “centralized speaker system[s],” where zone scenes (as described by the Court) could be created to improve the Sonos 2005 System.

369. Nourse also discloses the ability for a speaker that has been joined to a zone scene to operate independently from that zone scene until the zone scene is “invoked,” under the Court’s Order. *See, e.g.*, 4:53-55 (“remote units 130 each monitor the incoming message from the master unit 102 to determine whether it is being addressed either as an individual unit or as part of a



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group”). This is further disclosed in Nourse, for example in relation to Figure 4, reproduced below, where at step 406 “the field programming device communicates the Speaker Group A configured command to the remote unit 130” and later, while remote unit 130 is still in Group 1, “at step 422, the field programming device communicates a Speaker Page configure command to the remote unit 130.” Nourse at 7:37-39, 8:19-20.



(e) **Obviousness – Crestron**

370. To the extent it is found that the Sonos 2005 system did not explicitly disclose a “zone scene” as discussed in the Court’s Order, such features would have been obvious to a person of skill in the art, in view at least of the Sonos Forums, Nourse, and/or Crestron.

371. For example, as I described in Section X (incorporated herein by reference), Crestron also offered multi-room audio systems including speaker grouping and naming. For example, as shown below in a manual dated November 2005 and copyrighted 2005, Crestron offered multi-room audio including naming. The system supported up to 24 rooms where listeners in each room could “listen selectively” to different audio sources. The system was plug-and-play compatible with Crestron’s iPod connector, called “iPod Connect.” Further, the system supported

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“Room Groups,” which made “it simple to combine speakers in adjacent rooms, or switch into whole-house party mode, by letting the user link any number of rooms to function as one.” The Crestron system allowed up to 6 groups, and as shown in the image below, the rooms/groups would be identified by name, such as “Kitchen.” The system manual below did not provide other limitations on grouping—for example restricting which rooms could be grouped or not grouped.

## Crestron Adagio™ AES


### Entertainment System

The Adagio AES Entertainment System delivers a complete, cost-effective solution for high-performance multi-room audio distribution. Right out of the box, the AES provides sophisticated audio signal routing, processing, and amplification for up to 6 rooms, with extensive control from an enhanced LCD-driven front panel and a choice of room controllers.

**Multi-Room Audio**—The AES supports up to 6 sets of stereo room speakers, allowing listeners in each room to listen selectively to any of 10 different stereo sources. Its integrated multi-channel power amplifier delivers a robust 45 watts per channel to all rooms. Without requiring any programming, the AES can easily be expanded to support a total of 12 rooms by adding an AAE Audio Expander. Or, as many as 24 rooms can be handled using 3 AAE's with simple setup provided by Crestron Adagio Composer software.

**Enhanced Front Panel Control**—With its large backlit LCD display, Room and Group select buttons, 4 softkeys and dual rotary encoders, the AES front panel provides a very powerful, yet friendly user interface for controlling audio to a houseful of speakers. Custom naming of rooms, groups, and sources is facilitated on the LCD display, and also on the label strip using Crestron Engraver software.

**Room Groups**—The “Group” feature makes it simple to combine speakers in adjacent rooms, or switch into whole-house party mode, by letting the user link any number of rooms to function as one. Grouping lets you easily route one source to multiple rooms at once without the sync problems common to streaming-based systems. Up to 6 groups can be defined using the front panel Group buttons.



**Home Automation and Integration**—More than just an audio distribution system, the AES can actually grow as part of a complete home automation solution supporting all of Crestron's Cresnet and infinET controllable dimmers, shade controllers, thermostats, and so much more.

- > Out-of-the-box audio distribution for 6 rooms, expandable up to 24
- > Enhanced front panel setup and control
- > Choice of 12-button room keypads or APAD LCD controllers
- > Optional AM/FM, XM and Sirius Satellite Radio tuner cards
- > Plug-and-play support for Adagio Audio Server and iPod Connect
- > 2-Series Ethernet control system — programmable to support Crestron touchpanels, wireless remotes, lighting dimmers, thermostats, and much more!

**SPECIFICATIONS**

**Processor**

### Controls and LED Indicators

**STANDBY:** Pushbutton with green LED, turns off power amplifier

**MUTE:** Pushbutton with green LED, mutes audio in selected room or group

**MODE:** (8) Pushbuttons, select mode for adjustment: SOURCE, ROOM, HOUSE, MENU, BKLT, SCHED, DISPLAY, MORE (refer to manual)

**SOFTKEYS:** (4) LCD display-driven pushbuttons, select/activate various functions

**ROOM:** (6) Pushbuttons with green LEDs, labelling strip, select room to adjust

**GROUP:** (6) Pushbuttons with green LEDs, labelling strip, select group to adjust

**FUNCTION:** Continuous turn rotary encoder with adjoining “Select” pushbutton with green LED, for selecting and executing functions

**VOLUME:** Continuous turn rotary encoder, adjusts volume of selected room or group

**HW-R:** Hardware reset button recessed behind label strip, reboots the control system

**SW-R:** Software reset button recessed behind label strip, restarts the SIMPL program

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<https://manualzz.com/doc/2220267/crestron-adagio%E2%84%A2-aes>; [see also https://www.crestron.com/getmedia/aba893ef-04c0-493a-88dc-4ed7d365b8ac/mg\\_ams\\_1](https://www.crestron.com/getmedia/aba893ef-04c0-493a-88dc-4ed7d365b8ac/mg_ams_1) at 2, 3,

## Configure Preset Groups <sup>I</sup>

Preset groups can be created to group speakers in adjacent rooms with a specified source, or switch into a whole-house “party” mode, by letting the user link a source with any number of rooms. Changing the source in any one room changes the source in all of the rooms in the preset group.

To edit a preset group:

- Press the **ROOM** button to enter the *Room* mode.
- Press the **MORE** button.
- Press the soft button labeled **Groups** to display the list of groups.
- Turn the selection knob to highlight the group to be configured and press the soft button labeled **Setup**. The Edit Group control will be displayed.

### Edit Group Control

**Edit Group 3**

Source: No Source Selected

Name: Read

Theater: Not Included

Source    Name    Theater    Done

- Select the rooms in the preset group by pressing the corresponding room buttons on the AES or AAE (if connected). Each room button’s LED will turn on. Press again to remove the room from the preset group. The room button’s LED will turn off.
- Select a source for the preset group by pressing the soft button labeled **Source**. Turn the selection knob clockwise or counterclockwise until the desired source is displayed on the LCD and press the soft button labeled **Done**.
- Press the soft button labeled **Name** to change the name of the preset group. The group name controls will be displayed. Select letters (upper and lower-case) by turning the selection knob until the desired letter is displayed. Move the cursor to another position by pressing the soft buttons labeled **◀** and **▶**. To delete a character, press the soft button labeled **Del**.

**NOTE:** The maximum length for any preset group name is 16 characters.

- The theater room can be included in the group or excluded. To set the theater room’s inclusion, press the soft button labeled **Theater**.
- After editing the preset group, press **Done** to save the changes and return to the Groups listing.

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**(f) Obviousness – Yamaha**

It would also have been obvious to modify the Sonos System with the Yamaha system to add this claim limitation, to the extent it is not disclosed. This is at least because Yamaha discloses that a speaker can be part of multiple groups, and in order for a speaker to be part of two zone scenes or two groups at the same time, the zone scenes or zone groups must be able to be created separately from any invocation step. In addition, a POSITA would have been motivated to combine Yamaha with the Sonos System at least because users of playback systems considered Yamaha as an alternative to the Sonos System. *See e.g.*, SONOS-SVG2-00032289, SONOS-SVG2-00033695, SONOS-SVG2-00053679. As I described *e.g.* in Section X (and incorporate herein by reference), the Yamaha system discloses conventional speaker grouping, including multiple speakers that could be grouped into areas, which could then be divided into zones, which could also be divided into device groups, with master and slave devices in those groups. *See e.g.*, DME Manual at 3. at 183. The DME system disclosed creating “scenes” that could be named, saved, and recalled, and included particular configurations and preset parameters and were used in conjunction with the areas and zones. *See e.g.*, DME Manual at 5-6, 25-26, 55.

- 9. Limitation 1.7: “(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player;”**

372. I incorporated by reference my opinions from Limitation 1.6.

373. In my opinion, the Sonos System discloses or renders obvious this claim limitation.

374. As one example, Zone Player 3 may be the joinee group coordinator for a standalone group (containing only Zone Player 3). The user may select ZP3 in the Zone Menu,

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press the “Link Zone” button, and then select adding the “joiner” standalone group with ZP3 as the group coordinator. The result is a group comprising ZP3 + ZP1 with ZP3 as the group coordinator and ZP1 as the second group member. A user may also drop ZP1 from the previously created (see prior limitation) group of ZP2 + ZP1. Dropping ZP1 from this group causes ZP1 to operate in standalone mode. In the Sonos System, however, speakers are often operating in standalone mode because they may play back music individually while still being a part of the Party Mode as discussed above. Indeed, even when a speaker is joined to a group with group playback, other speakers not part of that group are part of the speakers that are a member of the Party Mode group, and the members of the group are member of Party Mode as well. Regardless, those speakers are in standalone mode with respect to Party Mode. As above, the “indication” may be a SetAVTransportURI SOAP action specifying a Rincon group URI with the group coordinator UUID. The playback is synchronous with the group coordinator / channel source because the Zone Player (1) configures its local channel sink to play the group coordinator’s channel source, (2) configures use of the channel source’s SNTP server for playback synchronization, and (3) adjusts playback using the clock offset, including adjusting the DAC clock rate to match the remote channel source’s clock rate.

375. A controller, such as the Windows desktop controller, drops the first Zone Player from a group by sending a BecomeCoordinatorOfStandaloneGroup SOAP action to the first Zone Player’s AVTransport control URI. Upon handling the BecomeCoordinatorOfStandaloneGroup SOAP action, the first Zone Player becomes the group coordinator and channel source of a standalone group (for which it is the only member). *See, e.g.:*

51. CRoomControl::OnZoneDrop(), V1.2\ v1.2-gold\pc\pccp\room\_control.cxx, 408–417 at 413–415

52. CJoinRoomsDlg::SetData(), V1.2\ v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 289–294

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53. CJoinRoomsDlg::Commit(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 107–227 at 199, 211

54. CJoinRoomsDlg::RemoveZonePlayerFromGroup(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 254–271 at 266

55. RAVTClient::BecomeCoordinatorOfStandaloneGroup(), V1.2\v1.2-gold\oc\protocol\client\src\avt\_client.cxx, 218–224

56. BecomeCoordinatorOfStandaloneGroup action, V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\AVTransport1.xml, 567–575

57. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 39–83 at 47, 80

58. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

59. RAVTServer::BecomeCoordinatorOfStandaloneGroupWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 457–473 at 465

60. RAVTMediaRenderer::BecomeCoordinatorOfStandaloneGroup(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 555–613 at 555–561, 572–578, 592–593

61. RGMZonePlayer::localConfigureGroup(), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 460–590

376. A controller, such as the Windows desktop controller, provides a user interface to add Zone Players from a “joiner” group to a “jinee” group. The controller adds the first Zone Player to a second jinee group by sending an SetAVTransportURI SOAP action, with the second jinee group’s Now Playing URI, to the first Zone Player’s AVTransport control URI. The Now Playing URI has the form “x-rincon:<GROUP COORDINATOR UUID>,” which embeds a UUID identifying the Zone Player that is the group coordinator for the second jinee group. The second jinee group includes a third Zone Player. *See, e.g.:*

62. CRoomControl::OnZoneAdd(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 389–406 at 394–396

63. CJoinRoomsDlg::SetData(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 289–294



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64. CJoinRoomsDlg::Commit(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 107–227 at 123–125, 152, 158

65. PCUtils::NowPlayingUriFromUDN(), V1.2\v1.2-gold\pc\pccp\pc\_utils.h, 61–65 at 63–64

66. RAVTClient::SetAVTransportURI(), V1.2\v1.2-gold\oc\protocol\client\src\avt\_client.cxx, 19–28

67. AVTransportURI action V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\AVTransport1.xml, 238–254

377. The first Zone Player receives a SetAVTransportURI SOAP action with a Rincon group URI that identifies the group to join (jinee group). The Rincon Group URI is the Now Playing URI that was sent by the controller. The Rincon Group URI has the form “x-rincon:<GROUP COORDINATOR UUID>,” which embeds a UUID identifying the Zone Player that is the group coordinator for the jinee group.

378. The first Zone Player handles the SetAVTransportURI SOAP action by extracting the group coordinator’s UUID from the URI, stopping the local channel sink, using the group coordinator’s UUID to determine the Group Management control URI, requesting the group coordinator via the Group Management control URI to add the first Zone Player to its group, and setting up the local channel sink to listen to and play the group coordinator’s channel source. The first Zone Player sends the AddMember SOAP action to the group coordinator to request addition to the group.

68. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 39–83 at 66, 80

69. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

70. RAVTServer::SetAVTransportURIWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 85–106 at 96–98

71. RAVTMediaRenderer::SetAVTransportURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 58–136 at 87–89



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72. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\ v1.2-gold\oc\zp\avt\_impl.cxx, 423–492 at 428–430, 440, 443–447, 460–466

73. RGMZonePlayer::localConfigureGroup(), V1.2\ v1.2-gold\oc\zp\gm\_impl.cxx, 460–590 at 525–526, 529, 532–536

74. RDeviceTopology::getGMControlURIFromRemoteUUID(), V1.2\ v1.2-gold\oc\zp\topology.cxx, 1067–1089

75. RGMClient::AddMember(), V1.2\ v1.2-gold\oc\protocol\client\src\gm\_client.cxx, 19–32

76. AddMember action, V1.2\ v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\GroupManagement1.xml, 26–45

379. As part of setting up the local channel sink to listen to and play the group coordinator's channel source, the Zone Player switches to the channel source as the Simple Network Time Protocol (SNTP) server for playback time monitoring. During playback, the channel sink uses the SNTP server to determine the clock offset from the server. The clock offset is used to adjust the actual play time. The channel sink also adjusts the digital-to-analog converter (DAC) clock speed to compensate for differences between the desired and actual play times. *See, e.g.:*

77. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\ v1.2-gold\oc\zp\avt\_impl.cxx, 423–492 at 466

78. RChannelSink::changeToRemoteSourceAndPlay(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 309–337 at 315–318

79. RChannelSink::setRemoteTransportSettings(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 663–695 at 679–680, 683–687, 689, 692

80. RChannelSourceTransportSettings::transportSettings(), V1.2\ v1.2-gold\oc\zp\srcbase.h, 47–56

81. RChannelSink::m\_SNTP, V1.2\ v1.2-gold\oc\zp\chsnk.h, 102–104

82. RChannelSink::notifySamples(), V1.2\ v1.2-gold\oc\zp\chsnk.cxx, 809–902 at 880–895

83. SNTPPollThread::convertServerTimeToLocalTime(), V1.2\ v1.2-gold\oc\zp\snppoll.cxx, 180–193

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965–1016 84. RChannelSink::monitorDACClock(), V1.2\v1.2-gold\oc\zp\chsnk.cxx,

157 85. RChannelSourceBase constructor, V1.2\v1.2-gold\oc\zp\srcbase.cxx, 102–

86. SNTPServerThread::threadFuncInternal(), V1.2\v1.2-gold\oc\zp\sntpsrv.cxx, 37–65 at 60

87. handleSntpRequest(), V1.2\v1.2-gold\oc\zp\sntp.cxx, 336–366

380. A Zone Player could simultaneously be a member of multiple different groups in existence at the same time.

381. As another example, ZP1 may be joined to ZP2 and ZP3 through the “party mode” / “all zones” group. In this instance, ZP1 will receive from the controller a second indication that the zone player is joined to the “party mode” group, which is configured for synchronous playback. Each of these options including Party Mode has been illustrated above. As another example, Sonos allows users to wire speakers to the Zone Players in multiple configurations due to the wiring options included with each zone player. Accordingly, any zone player may be connected to speakers in the same room, different rooms, or even speakers connected to different zone players, allowing for freedom for the user to create multi-room and overlapping speaker setups, as Sonos encouraged above.

Your ZonePlayer 80(s) can then be connected to your existing audio system(s) via analog or digital outputs. In my testing, I connected the “base” ZP80—the one near my computer—to both a HeadRoom Desktop Amp for high-quality headphone listening and various “computer” speakers for listening out loud. (The ZP80, like its bigger sibling, doesn’t include a headphone jack.) I connected another ZP80 to a Focal-JMLab iCub amplifier/subwoofer with NHT satellites in my living room.

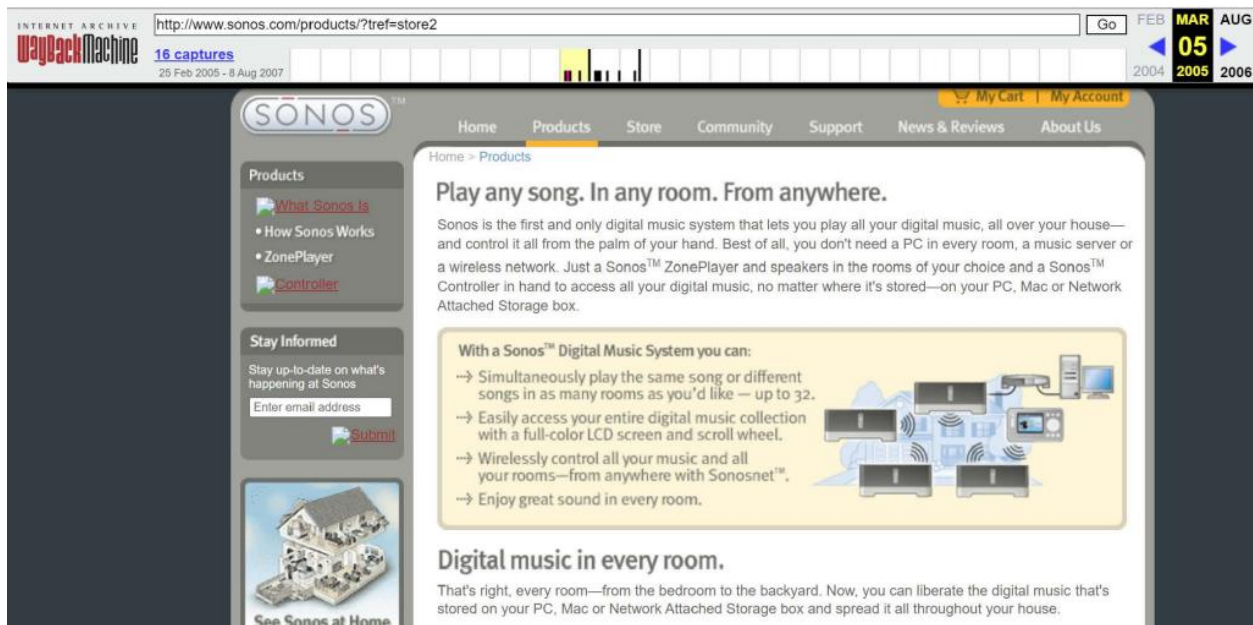
IA at 198.

### (b) Obviousness – POSITA

382. In the alternative, this claim limitation discloses nothing more than overlapping speaker groups, which would have been obvious to a person of skill in the art at the time. Indeed,

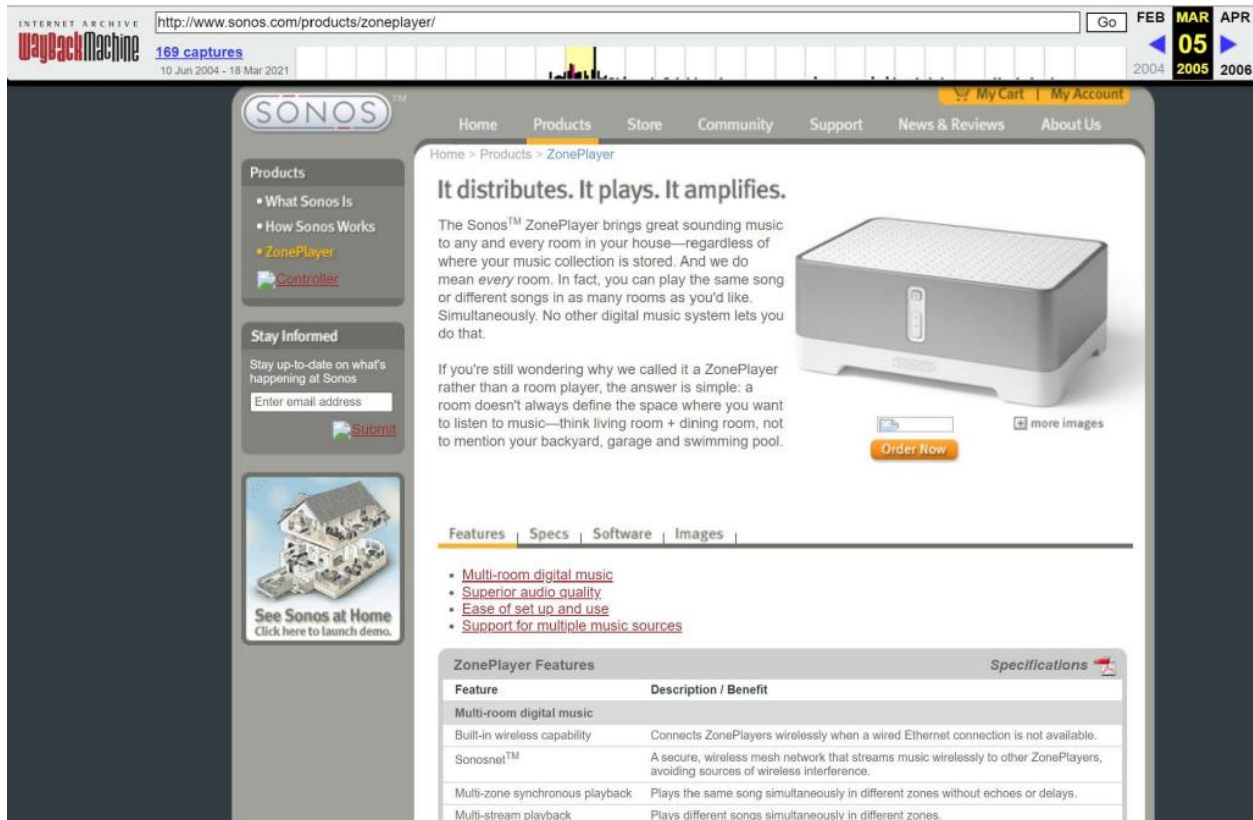
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the Sonos System already disclosed having groups and also having a “Party Mode” / “All Zones” group, which would necessarily encompass any groups already created and therefore disclose overlapping groups. A person of skill in the art would have been motivated to add overlapping groups because Sonos’s own marketing materials touted the benefits of playing any song, in any room, from anywhere, including the ability to “simultaneously play the same song or different songs in as many rooms as you’d like.”

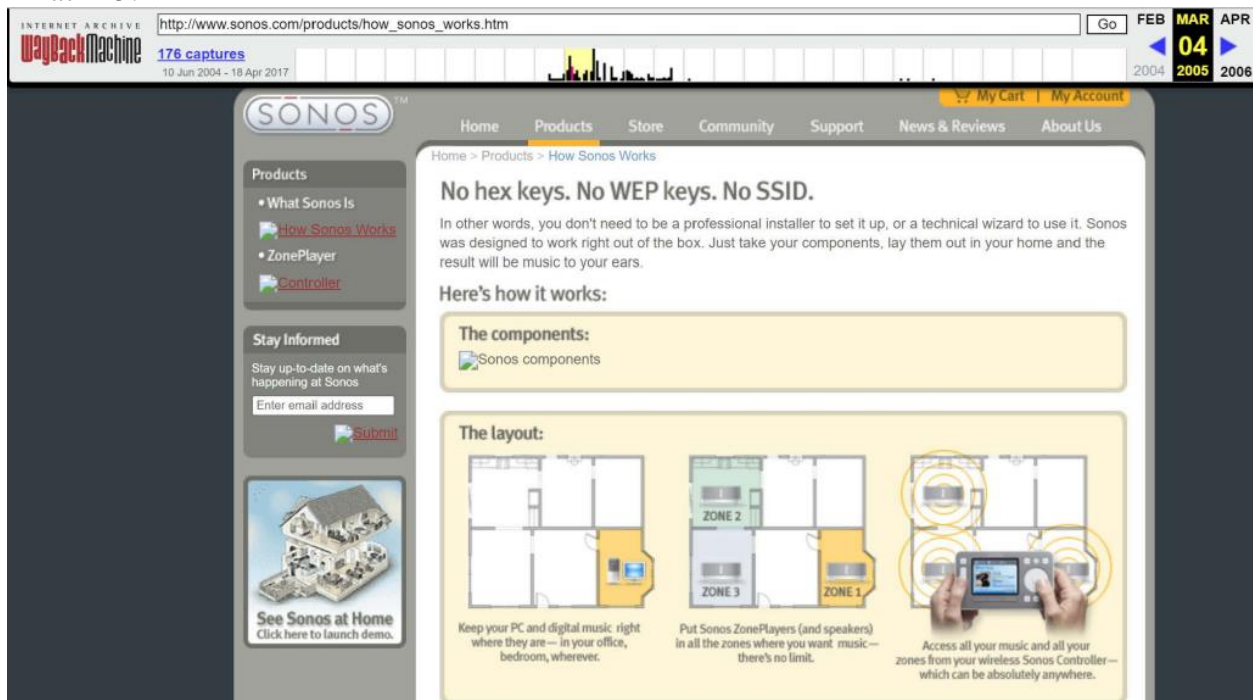


IA at 123.

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IA at 125.



IA at 135.

383. A person of skill in the art would have recognized that by allowing a user to create speaker groups, those groups may either (1) allow overlapping group membership or (2) not allow

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overlapping group membership. Given that allowing overlapping group membership may be attractive to certain users because there was a recognized “need for dynamic control of the audio players as a group,” it would have been obvious to select allowing overlapping group membership when implementing speaker groups. ’885 patent at 1:30-34.

**(c) Obviousness – Nourse**

384. A person of skill in the art would also have been motivated to combine the Sonos System with Nourse, which discloses a plurality of speakers, each of which has “a unique 16-bit address.” Nourse, 3:57-58. “Each of the speakers also can be assigned up to four group identifiers.” *Id.* at 3:58-59. The group identifier “allows specific speakers to be assigned to a group and receive the same signal.” *Id.* at 3:61-63. Thus, any speaker “can be assigned to more than one group.” *Id.* at 4:5. Nourse is analogous to the ’885 patent because it is in the same field of endeavor, “controlling or manipulating a plurality of multimedia players in a multi-zone system.” ’885 patent, 1:30-34. For example, Nourse, like the ’885 patent, explains that it is directed to “a centralized speaker system that allows multiple speakers connected to a central amplifier speaker line to be monitored and controlled from a central location via a master/slave protocol.” Nourse at Abstract. Nourse is also reasonably pertinent to the problem to be solved by the ’885 patent, “dynamic control of the audio players as a group.” For example, Nourse explains that speakers may be “addressed individually or as part of a group” by “receiving unique content specific, respectively, to the individual remote speaker address and group address” (*id.* at 2:35-39) where the group address or identifier “allows specific speakers to be assigned to a group and receive the same signal” and play back audio as a group (*id.* at 3:61-63). Nourse teaches additional means for improving the user experience by allowing a user to add a playback device to multiple groups. Nourse at 3:57-4:5. It would have been desirable to allow a user to have a particular zone player join multiple groups (e.g., the kitchen and patio could be grouped for outside entertainment, and

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the kitchen and living room could be grouped for inside entertainment). Having a speaker join multiple groups would increase the number of customized combinations a user could configure in their home, as the Sonos System and Webpage recognize as an important feature.

**(d) Obviousness – Rajapakse (US 8,239,559)**

385. A person of skill in the art would have found it obvious to combine Rajapakse with the Sonos System. Rajapakse was cited by many Sonos patents regarding speaker grouping, including patents from the same family as the '885 patent, indicating that persons of skill in the art recognized that Rajapakse was highly relevant to the claimed features. For example, Mr. Lambourne in prosecuting US 2013/0251174 disclosed Rajapakse as relevant prior art. 2014-04-17 Information Disclosure Statement. Rajapakse was also cited by the following patents—which are closely related to the '885 patent.

US20130251174A1	Sonos, Inc.	Controlling and manipulating groupings in a multi-zone media system
US8788080B1	Sonos, Inc.	Multi-channel pairing in a media system
US9226087B2	Sonos, Inc.	Audio output balancing during synchronized playback
US9226073B2	Sonos, Inc.	Audio output balancing during synchronized playback
US9456279B1	Google Inc.	Automatic control and grouping of media playback devices based on user detection
US9671997B2	Sonos, Inc.	Zone grouping
US9729115B2	Sonos, Inc.	Intelligently increasing the sound level of player
US10209948B2	Sonos, Inc.	Device grouping
US10306364B2	Sonos, Inc.	Audio processing adjustments for playback devices based on determined characteristics of audio content
US10331399B2	Apple Inc.	Smart audio playback when connecting to an audio output system
US10356526B2	Razer (Asia-Pacific) Pte. Ltd.	Computers, methods for controlling a computer, and computer-readable media
US10516718B2	Google LLC	Platform for multiple device payout
US11265652B2	Sonos, Inc.	Playback device pairing

386. Rajapakse discloses this claim limitation.

387. For example, Rajapakse discloses dynamic playback among many speakers in groups. Rajapakse at 13:41-45 (“There may be multiple streams of audio being sent to multiple



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media renderers 203 in multiple zones at the same time. . . As an example, a media renderer may be the front left channel when a movie is being played to a screen that is centered between it and the front right. This would be configured as default movie stream. This same media renderer may be configured also to be the back left channel when playing a default HiFi audio stream, where hi performance front media renderers are positioned elsewhere in the room.”).

388. Rajapakse also discloses synchronized playback in speaker groups. Rajapakse at 11:60-65 (“The rendition of each stream by a media renderer 203 (speaker) needs to be synchronized in time. This is enabled by the distribution server 204 working with the media renderer 203, using a stream protocol specific to the media renderers 203. This protocol includes the methods to time-synchronize rendition of the stream.”).

389. Rajapakse discloses dynamic grouping and transitioning speakers among different groups. Rajapakse at 3:65-67 (“If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.”).

390. Rajapakse discloses that each player/speaker may be a part of multiple groups. Rajapakse at 4:47-54 (“Each media renderer 203 is set up with a variety of properties including lists of acceptable zone identifications, acceptable zone manager identifications, acceptable zone 50 control point identifications, lists of acceptable stream identifications, rendition properties such as volume and role properties.”).

391. Rajapakse discloses having many properties for players within a speaker group and therefore discloses “zone scenes.” Rajapakse at 4:53-67 (“One of these properties, the 'role' of a media renderer 203, can define what stream channel the media renderer 203 will 55 play back. Each audio data stream may include multiple channels, where each channel is defined as front left,

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center, front right, back left, back center, back right, subwoofer, etc. The media renderer 203 can be configured to accept one of the channels in the stream. If the stream does not contain the channel the media renderer 203 is configured for, it may be configured to play an alternate channel or not play anything. In addition to the channel type roles, a media renderer's role may include other 'roles.' A media renderer's role could be to play only deep base sounds, or to play only high pitch sounds in the media. As another example, a media renderer's role may be to provide special effects, such as echoes or background sounds. As a further example, a media renderer's role may be to play pre-recorded media segments at various points of the media stream. For example, a media renderer 203 may play pre-recorded media segments on initiation by a control point or zone manager, or based on sensing various states or conditions, such as powering up the media renderer, or detecting a sensor condition.”).

392. Rajapakse discloses overlapping groups or zones, and therefore overlapping speakers within those zones. Rajapakse at 5:61-67 (“A zone is a physical space that a number of media renderers belong to and within which the media renderers are physically located. Typically a zone is a listening space, a space where the audio from all the media renderers in the space can be heard. For example, all media renderers within a single auditorium will be in the same zone. Zones may overlap and may include other zones.”).

393. Rajapakse discloses that speakers may be a member of more than one group. Rajapakse at 6:1-4 (“Each media renderer 203 is assigned to one or more zones. Zones are typically identified with a Zone Identifier (ZID).”).

394. Rajapakse discloses dynamic zone and speaker management. 6:6-19 (“The zone manager 210 dynamically gathers and aggregates information on the media renderers 203 in its vicinity and makes this information available to other services. . . . In addition to gathering media renderer information, the zone manager 210 holds information specific to a zone, manages the

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media renderers 203 in the zone, and may provide additional services and actions, such as media renderer reservation to other services such as control points 201. . . . The zone control point 209 is an enhanced version of a standard control point 201. The enhancements allow the zone control point 209 to interact with the zone manager 210 to quickly gather information on sets of media renderers 203 in a zone and perform actions on the zone.”).

395. Rajapakse discloses zone management that is dynamic. Rajapakse at 12:51-59 (“Once a zone manager 210 registers a media renderer 203, the zone manager 210 may view and modify the media renderer's setup by interacting with a user directly or via a control point 201. This includes modifying the media renderer's zone list, default stream list, role, and properties such as volume.”).

**(e) Obviousness – Millington**

396. A person of skill in the art would have been motivated to combine Millington with the Sonos System because Mr. Millington worked on the Sonos System and therefore would have been an obvious choice to look to for guidance about potential modifications to that system. Mr. Millington’s patents also described aspects of the Sonos System or aspects related to how those systems practice group synchronization and therefore a POSITA would have looked to Millington to understand the Sonos System. Millington was also assigned to Sonos and was filed in the same timeframe as the Sonos System was released.

397. Millington discloses this claim limitation.

398. Millington discloses standalone speakers and synchronous groups. Millington at 6 (“In the following, the term "synchrony group" will be used to refer to a set of one or more zone players that are to play the same audio program synchronously. Thus, in the above example, zone players 11(1) and 11(2) comprise one synchrony group, zone player 11(3) comprises a second synchrony group, zone players 11(4) and 11(5) comprise a third synchrony group, and zone player

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11(6) comprises yet a fourth synchrony group. Thus, while zone players 11(1) and 11(2) are playing the same audio program, they will play the audio program synchronously.”); 6 (“Similarly, while zone players 11(4) and 11(5) are playing the same audio program, they will play the audio program synchronously.”).

399. Millington discloses using dynamic groups. Millington at 7 (“In the network audio system 10, the synchrony groups are not fixed. Users can enable them to be established and modified dynamically. Continuing with the above example, a user may enable the zone player 11(1) to begin providing playback of the audio program provided thereto by audio information source 14(1)(1), and subsequently enable zone player 11(2) to join the synchrony group. Similarly, a user may enable the zone player 11(5) to begin providing playback of the audio program provided thereto by audio information source 14(5)(2), and subsequently enable zone player 11(4) to join that synchrony group. In addition, a user may enable a zone player to leave a synchrony group and possibly join another synchrony group. For example, a user may enable the zone player 11(2) to leave the synchrony group with zone player 11(1), and join the synchrony group with zone player 11(6). As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.”); Millington at 41 (“The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.”).

400. Millington discloses overlapping speaker groups. Millington at 17 (“As noted above, there may be multiple synchrony groups in the network audio system 10, and further that, for example, a zone player 11(n) may operate both as a master device 21 or a slave device 22(g) in one synchrony group, and as the audio information channel device 23 providing audio and

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playback timing information and clock timing information for another synchrony group.”); 19 (“Indeed, it will be appreciated that the zone player that is utilized as the audio information channel device for synchrony group 20(2) may also be a zone player that is utilized as the master device 21(1) or a slave device 22(1)(1),..., 22(K)(1) in the synchrony group 20(1).”).

**(f) Obviousness – Lindemann**

401. A person of skill in the art would have found it obvious to combine Lindemann with the Sonos System. Lindemann was cited by many Sonos patents regarding speaker grouping, including patents from the same family as the ’885 patent, indicating that persons of skill in the art recognized that Lindemann was highly relevant to the claimed features. For example, US 2013/0251174 cited to Lindemann. Lindemann and the Sonos System are both in the same field of endeavor. Lindemann Abstract (“A digital wireless loudspeaker system includes an audio transmission device for selecting and transmitting digital audio data, and wireless speakers for receiving the data and broadcasting sound. . . . Status messages are included in the transmission frames to control speaker attributes such as speaker group, enabling or disabling a sub-woofer, and volume of the loudspeaker digitally.”).

402. Lindemann discloses overlapping speaker groups. Lindemann at 0064 (“Many homes and offices have multiple groups of loudspeakers—e.g. a group of loudspeakers in the living room and another group in the kitchen. The Group Selection Switch allows a loudspeaker to be assigned to one of many groups of loudspeakers.”).

**(g) Obviousness – Squeezebox**

403. As Mr. Lambourne testified, he was aware of Squeezebox given its competitive nature with the Sonos System. *Supra*. Others including reviewers recognized Sonos System as a competitor of Squeezebox. *Supra*. As such, a person of skill in the art, just like the inventor of the patent, would have been motivated to look to Squeezebox and combine aspects of the two

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systems. And as discussed below, Squeezebox discloses this claim limitation.

**(h) Obviousness – Sonos Forums**

404. It would also have been obvious to modify the Sonos System with Sonos Forums to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.6. For example, the Sonos Forums described *supra* (and fully incorporated herein by reference), disclose adding the first zone player to a second zone scene including the first and third zone player that can be configured for synchronous playback of media when the second zone scene is invoked. As discussed with respect to Limitation 1.6, the Sonos Forums disclose grouping the zone players of the Sonos System into overlapping groups that play back music synchronously, just as non-overlapping zone scenes do in the Sonos System.

**(i) Crestron**


405. As I addressed below in relation to Limitation 1.6, it would also have been obvious to modify the Sonos System with Crestron to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.6. For example, Crestron also offered multi-room audio systems including speaker grouping and the ability for a speaker to be part of multiple speaker groups. For example, as shown below in a manual dated November 2005 and copyrighted 2005, Crestron offered multi-room audio. The system manual below did not provide other limitations on grouping—for example restricting which rooms could be grouped or not grouped.



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# Crestron Adagio™ AES

## Entertainment System



The Adagio AES Entertainment System delivers a complete, cost-effective solution for high-performance multi-room audio distribution. Right out of the box, the AES provides sophisticated audio signal routing, processing, and amplification for up to 6 rooms, with extensive control from an enhanced LCD-driven front panel and a choice of room controllers.

**Multi-Room Audio**—The AES supports up to 6 sets of stereo room speakers, allowing listeners in each room to listen selectively to any of 10 different stereo sources. Its integrated multi-channel power amplifier delivers a robust 45 watts per channel to all rooms. Without requiring any programming, the AES can easily be expanded to support a total of 12 rooms by adding an AAE Audio Expander. Or, as many as 24 rooms can be handled using 3 AAE's with simple setup provided by Crestron Adagio Composer software.

**Enhanced Front Panel Control**—With its large backlit LCD display, Room and Group select buttons, 4 softkeys and dual rotary encoders, the AES front panel provides a very powerful, yet friendly user interface for controlling audio to a houseful of speakers. Custom naming of rooms, groups, and sources is facilitated on the LCD display, and also on the label strip using Crestron Engraver software.

**Room Groups**—The "Group" feature makes it simple to combine speakers in adjacent rooms, or switch into whole-house party mode, by letting the user link any number of rooms to function as one. Grouping lets you easily route one source to multiple rooms at once without the sync problems common to streaming-based systems. Up to 6 groups can be defined using the front panel Group buttons.

**Home Automation and Integration**—More than just an audio distribution system, the AES can actually grow as part of a complete home automation solution supporting all of Crestron's Cresnet and infiNET controllable dimmers, shade controllers, thermostats, and so much more.

- > Out-of-the-box audio distribution for 6 rooms, expandable up to 24
- > Enhanced front panel setup and control
- > Choice of 12-button room keypads or APAD LCD controllers
- > Optional AM/FM, XM and Sirius Satellite Radio tuner cards
- > Plug-and-play support for Adagio Audio Server and iPod Connect
- > 2-Series Ethernet control system — programmable to support Crestron touchpanels, wireless remotes, lighting dimmers, thermostats, and much more!

**SPECIFICATIONS**

**Processor**

### Controls and LED Indicators

**STANDBY:** Pushbutton with green LED, turns off power amplifier

**MUTE:** Pushbutton with green LED, mutes audio in selected room or group

**MODE:** (8) Pushbuttons, select mode for adjustment: SOURCE, ROOM, HOUSE, MENU, BKLT, SCHED, DISPLAY, MORE (refer to manual)

**SOFTKEYS:** (4) LCD display-driven pushbuttons, select/activate various functions

**ROOM:** (6) Pushbuttons with green LEDs, labelling strip, select room to adjust

**GROUP:** (6) Pushbuttons with green LEDs, labelling strip, select group to adjust

**FUNCTION:** Continuous turn rotary encoder with adjoining "Select" pushbutton with green LED, for selecting and executing functions

**VOLUME:** Continuous turn rotary encoder, adjusts volume of selected room or group

**HW-R:** Hardware reset button recessed behind label strip, reboots the control system

**SW-R:** Software reset button recessed behind label strip, restarts the SIMPL program

<https://manualzz.com/doc/2220267/crestron-adagio%E2%84%A2-aes>; [see also](#)

[https://www.crestron.com/getmedia/aba893ef-04c0-493a-88dc-4ed7d365b8ac/mg\\_ams\\_1](https://www.crestron.com/getmedia/aba893ef-04c0-493a-88dc-4ed7d365b8ac/mg_ams_1) [at 2, 3,](#)

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## Configure Preset Groups <sup>I</sup>

Preset groups can be created to group speakers in adjacent rooms with a specified source, or switch into a whole-house “party” mode, by letting the user link a source with any number of rooms. Changing the source in any one room changes the source in all of the rooms in the preset group.

To edit a preset group:

- Press the **ROOM** button to enter the *Room* mode.
- Press the **MORE** button.
- Press the soft button labeled **Groups** to display the list of groups.
- Turn the selection knob to highlight the group to be configured and press the soft button labeled **Setup**. The Edit Group control will be displayed.

### Edit Group Control

- Select the rooms in the preset group by pressing the corresponding room buttons on the AES or AAE (if connected). Each room button’s LED will turn on. Press again to remove the room from the preset group. The room button’s LED will turn off.
- Select a source for the preset group by pressing the soft button labeled **Source**. Turn the selection knob clockwise or counterclockwise until the desired source is displayed on the LCD and press the soft button labeled **Done**.
- Press the soft button labeled **Name** to change the name of the preset group. The group name controls will be displayed. Select letters (upper and lower-case) by turning the selection knob until the desired letter is displayed. Move the cursor to another position by pressing the soft buttons labeled **◀** and **▶**. To delete a character, press the soft button labeled **Del**.

**NOTE:** The maximum length for any preset group name is 16 characters.

- The theater room can be included in the group or excluded. To set the theater room’s inclusion, press the soft button labeled **Theater**.
- After editing the preset group, press **Done** to save the changes and return to the Groups listing.

### (j) Obviousness – Yamaha

406. It would also have been obvious to modify the Sonos System with the Yamaha system to add this claim limitation, to the extent it is not disclosed. This is at least because Yamaha

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discloses that a speaker can be part of multiple groups, and in order for a speaker to be part of two zone scenes or two groups at the same time, the zone scenes or zone groups must be able to be created separately from any invocation step. In addition, a POSITA would have been motivated to combine Yamaha with the Sonos System at least because users of playback systems considered Yamaha as an alternative to the Sonos System. *See e.g.*, SONOS-SVG2-00032289, SONOS-SVG2-00033695, SONOS-SVG2-00053679. As I described *e.g.* in Section X (and incorporate herein by reference), the Yamaha system discloses conventional speaker grouping, including multiple speakers that could be grouped into areas, which could then be divided into zones, which could also be divided into device groups, with master and slave devices in those groups. *See e.g.*, DME Manual at 3. at 183. The DME system disclosed creating “scenes” that could be named, saved, and recalled, and included particular configurations and preset parameters and were used in conjunction with the areas and zones. *See e.g.*, DME Manual at 5-6, 25-26, 55.

**10. Limitation 1.8: “after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation;”**

407. In my opinion, the Sonos System discloses this claim limitation.

408. Sonos argues that this claim limitation is disclosed based on the following arguments made in its Reply summary judgment briefing:

Third, the '885 Patent discloses that a “zone scene” is a group of “zone players” that is “predefined” and “saved” for future use during a “setup” phase, but is not activated for synchronous playback at that time. *Supra* II.B.i; '885 Pat., 8:45-51, 10:4-19, 10:36-52, 11:12-19; D.I. 249-11, 1-2, 9-16; Ex. R, ¶55. Rather, the predefined group of “zone players” initially exists in an inactive state, which is what the '885 Patent explains when distinguishing a “zone scene” from an ad-hoc group that is automatically activated at the time it is formed rather than being predefined and saved for future use. *Id.* In this respect, the '885 Patent discloses that, unlike for an ad-hoc group, the act of adding “zone players” to a “zone scene” does not cause those “zone players”

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to become linked together for synchronous playback at that time. Ex. R, ¶53. This conveys to a POSITA that a “zone player” operating in “standalone mode” prior to being added to each new “zone scene” will continue to operate in “standalone mode” after being added to each new “zone scene.” *Id.*

Fourth, the ’885 Patent discloses that the subsequent act of “invoking” a “zone scene” is what activates the “zone scene” for synchronous playback by causing the “zone players” in the invoked “zone scene” to become configured to play audio in synchrony in accordance with a given “zone scene.” *Supra* II.B.i; ’885 Pat., 9:16-20, 10:53-63; Ex. R, ¶56.

409. I have excerpted the portions of the specification that Sonos cites as support for this claim limitation below:<sup>10</sup>

According to one embodiment, a set of zones can be dynamically linked together using one command. Using what is referred to herein as a theme or a zone scene, zones can be configured in a particular scene (e.g., morning, afternoon, or garden), where a predefined zone grouping and setting of attributes for the grouping are automatically effectuated.

8:45-51.

FIG. 5A shows a user interface 500 to allow a user to form a scene. The panel on the left shows the available zones in a household. The panel on the right shows the zones that have been selected and be grouped as part of this scene. Depending on an exact implementation of a user interface, Add/Remove buttons may be provided to move zones between the panels, or zones may be dragged along between panels. FIG. 5B shows another user interface 520 to allow a user to form a scene. The user interface 520 that may be displayed on a controller or a computing device, lists available zones in a system. The list of zones in the user interface 520 includes ALL the zones in the system, including the zones that are already grouped. A checkbox is provide next to each of the zones so that a user may check in the zones to be associated with the scene.

10:4-19.

The process 600 is presented in accordance with one embodiment of the present invention and may be implemented in a module to be located in the memory 282 of FIG. 2C.

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<sup>10</sup> DI 249-11 is a cover sheet stating that Exhibit 7 was filed under seal. Sealed Exhibit 7, which is DI 248-6, only has four pages and therefore does not match the pincites to pages 1-2 and 9-16 that Sonos provided. Therefore neither of these documents appear to be the material relied upon by Sonos. To the extent Sonos correctly identifies the document it intends to rely upon, I reserve my rights to respond to any such evidence.

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The process 600 is initiated only when a user decides to proceed with a zone scene at 602. The process 600 then moves to 604 where it allows a user to decide which zone players to be associated with the scene. For example, there are ten players in a household, and the scene is named after “Morning”. The user may be given an interface to select four of the ten players to be associated with the scene. At 606, the scene is saved. The scene may be saved in any one of the members in the scene. In the example of FIG. 1, the scene is saved in one of the zone players and displayed on the controller 142. In operation, a set of data pertaining to the scene includes a plurality of parameters. In one embodiment, the parameters include, but may not be limited to, identifiers (e.g., IP address) of the associated players and a playlist. The parameters may also include volume/tone settings for the associated players in the scene. The user may go back to 602 to configure another scene if desired.

10:36-52

FIG. 7 shows an example user interface for invoking a zone scene. The user interface of FIG. 7 shows a Zone Menu that includes selectable indications of zone scenes.

FIG. 8 shows another example user interface for invoking a zone scene. FIG. 8 shows a Zone Menu that includes a softkey indicating a Scenes menu. Pressing the Scenes softkey will show the Scenes menu where all the available zone scenes are shown as selectable indications.

11:12-19

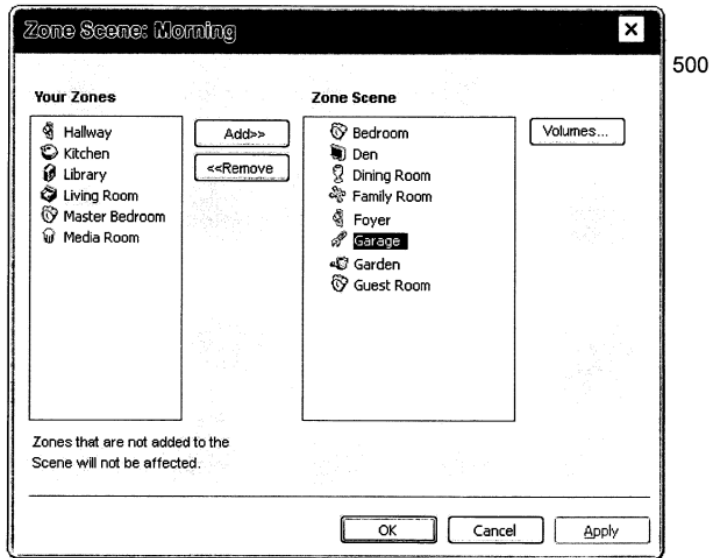
410. Sonos claims that these citations disclose that because the allegedly disclosed “predefined group of ‘zoneplayers’ initially exists in an inactive state . . . the ’885 Patent discloses that, unlike for an ad-hoc group, the act of adding ‘zone players’ to a ‘zone scene’ does not cause those ‘zone players’ to become linked together for synchronous playback at that time.” And therefore “[t]his conveys to a POSITA that a ‘zone player’ operating in ‘standalone mode’ prior to being added to each new ‘zone scene’ will continue to operate in ‘standalone mode’ after being added to each new ‘zone scene.’” In other words, Sonos argues that having a “zone scene” that is not automatically activated discloses the limitation.

411. In the Sonos System, the “Party Mode” exists at all times because it is a default “zone scene” and therefore it exists prior to it being “invoked” as claimed. Under Sonos’s understanding of the claims, therefore, “Party Mode” discloses this claim limitation.



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412. Further, the figures that Sonos relies upon to show this claim limitation was disclosed in the '885 patent are very similar to the same user interface used in the Sonos System. For example, Sonos relies upon Figure 5A, below.



**FIG. 5A**

413. The user interface of the Sonos System also allows Zones to be grouped together (or ungrouped) in nearly the same manner:

**To add a zone to a zone group**

1. Touch the **Zones** button on your Controller.



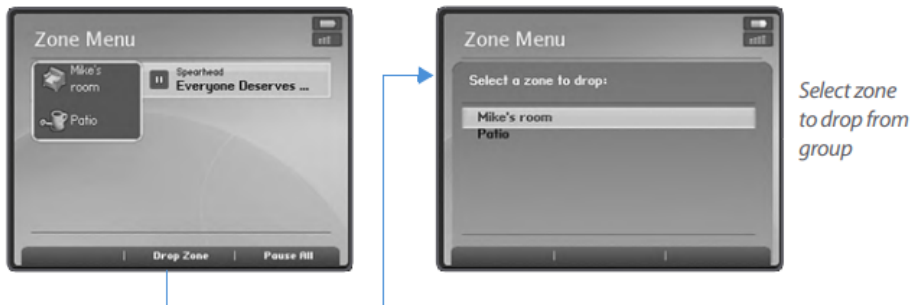
2. Highlight the zone or zone group you want to add a zone to, and touch **Link Zone**.



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### To drop a room from your zone group

1. Touch the **Zones** button on your Controller.



2. Use the scroll wheel to highlight the zone group you want to change, and touch **Drop Zone**.
3. Highlight the zone you want to drop from the group, and touch **OK**. The room that's removed from the zone group stops playing music. The other zones in the zone group continue unaffected.

Lambourne Dep. Ex. 1078 at 4-5.

414. Further, as discussed above, Sonos has taken the position that “standalone mode” includes having a zone player not playback any media. *Supra*. In the normal course of using the Sonos System, “any zones you link will automatically drop their current music queue and begin to play the music queue from the highlighted zone.” However, “if you select link zone from a zone where there is no music playing, any zone you link to it will also be silent.” Accordingly, silent zones may remain in standalone mode even when added to different groups if the groups that they are added to are silent and depending on the order in which they are added to that group.

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**To link a zone to a zone group**

You can create a zone group first and then select music to play, or you can add a zone to a zone group where music is already playing.



**Note:** Any zones you link will automatically drop their current music queue and begin to play the music queue from the highlighted zone. You may sometimes want to save your music queue before linking a zone. See "To create a Sonos playlist" on page 3-17.

1. From the **Zones** pane, highlight the zone you want to link another zone or zone group to.
2. Choose one of the following options:
  - Click **Link Zone**.

Or,

- From the **Zones** menu, click **Link Zone**.



3. Select a zone to add to the group, and click **OK**. If you want to join all the zones in your house to this music queue, select **All Zones-Party Mode**. All of your ZonePlayers will then play the same music until you drop the zones from the zone group.



**Note:** The order in which you add a zone makes a difference. If you select **Link Zone** from a zone where there is no music playing, any zone you link to it will also be silent.

Lambourne Dep. Ex. 1077 at 30.

415. As another example, as discussed in some of the examples above, ZP1 may be in standalone mode when it is dropped from a group. In particular, the ZP1 may be dropped from the second joinee group (second zone scene). Subsequently, the controller may add ZP1 to either the first joinee group (first zone scene) or second joinee group (second zone scene). A controller, such as the Windows desktop controller, may drop the first Zone Player from a group by sending a BecomeCoordinatorOfStandaloneGroup SOAP action to the first Zone Player's AVTransport control URI. Upon handling the BecomeCoordinatorOfStandaloneGroup SOAP action, the first Zone Player becomes the group coordinator and channel source of a standalone group (for which

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it is the only member). *See, e.g.:*

88. CRoomControl::OnZoneDrop(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 408–417 at 413–415

89. CJoinRoomsDlg::SetData(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 289–294

90. CJoinRoomsDlg::Commit(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 107–227 at 199, 211

91. CJoinRoomsDlg::RemoveZonePlayerFromGroup(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 254–271 at 266

92. RAVTClient::BecomeCoordinatorOfStandaloneGroup(), V1.2\v1.2-gold\oc\protocol\client\src\avt\_client.cxx, 218–224

93. BecomeCoordinatorOfStandaloneGroup action, V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\AVTransport1.xml, 567–575

94. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 39–83 at 47, 80

95. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

96. RAVTServer::BecomeCoordinatorOfStandaloneGroupWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 457–473 at 465

97. RAVTMediaRenderer::BecomeCoordinatorOfStandaloneGroup(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 555–613 at 555–561, 572–578, 592–593

98. RGMZonePlayer::localConfigureGroup(), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 460–590

416. A controller, such as the Windows desktop controller, provides a user interface to add Zone Players from a “joiner” group to a selected “joinee” group. When a joinee group is selected in the Zones dialog, selecting the Link Zones menu entry or pressing the Link Zones button brings up a Link Zone modal dialog to select joiner groups to add to the joinee group. The Link Zone dialog also includes a special “[All Zones — Party Mode]” item to add all Zone Players in the household to the joinee group. *See, e.g.:*

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99. CRoomListView::FireSelectionChange(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 355–385 at 357–368

100. ID\_ZONE\_ADD (“&Link Zone...”) menu item, V1.2\v1.2-gold\pc\pccp\room-control.cxx, 1056

101. CRoomControl::OnInitDialog(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 27–56 at 32, 39, 88

102. IDS\_ZONES (“Zones”), V1.2\v1.2-gold\pc\rs\_dll\en-US\en-US.rc, 1885

103. IDC\_BUTTON\_JOIN handled by OnJoinRoom, V1.2\v1.2-gold\pc\pccp\room\_control.h, 38

104. CRoomControl::OnJoinRoom(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 240–244 at 242

105. CRoomControl::OnZoneCommand(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 161–186 at 172

106. CRoomControl::OnZoneAdd(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 389–406 at 394–396

107. CJoinRoomsDlg::IDD (IDD\_JOINROOMS), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.h, 28

108. IDD\_JOIN\_ROOMS dialog caption (“Link Zone”), V1.2\v1.2-gold\pc\res\_dll\en-US\en-US.rc, 311–325 at 314

109. CJoinRoomDlg::Refresh(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 343–375 at 348–365

110. IDS\_PARTY\_MODE\_ITEM (“[All Zones – Party Mode]”), V1.2\v1.2-gold\pc\res\_dll\en-US\en-US.rc, 2117

417. The controller may add the first Zone Player to the selected joinee group by sending an SetAVTransportURI SOAP action, with the selected joinee group’s Now Playing URI, to the first Zone Player’s AVTransport control URI. The Now Playing URI has the form “x-rincon:<GROUP COORDINATOR UUID>,” which embeds a UUID identifying the Zone Player that is the group coordinator for the selected joinee group. The selected joinee group is one of either the first joinee group (which contains the second Zone Player) or the second joinee group (which contains the third Zone Player). *See, e.g.:*

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111. CRoomControl::OnZoneAdd(), V1.2\v1.2-gold\pc\pccp\room\_control.cxx, 389–406 at 394–396

112. CJoinRoomsDlg::SetData(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 289–294

113. CJoinRoomsDlg::Commit(), V1.2\v1.2-gold\pc\pccp\join\_rooms\_dlg.cxx, 107–227 at 123–125, 152, 158

114. PCUtils::NowPlayingUriFromUDN(), V1.2\v1.2-gold\pc\pccp\pc\_utils.h, 61–65 at 63–64

115. RAVTClient::SetAVTransportURI(), V1.2\v1.2-gold\oc\protocol\client\src\avt\_client.cxx, 19–28

116. AVTransportURI action V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\AVTransport1.xml, 238–254

**(b) Obviousness – POSITA**

418. In the alternative, it would have been obvious to a person of skill in the art to allow the Zone Players to remain in standalone mode as claimed. Indeed, the inventor wrote that there were only three possibilities for the behavior when a speaker is added to a group, as shown below in an excerpt from the provisional appendices in numbers 1-3.

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### 1.1.3 What happens to the Music that's already playing when a Zone Scene is started.

If no music is playing in any Zone – then the zones will simply link in a group.

If music is playing in one or more zones there are several possibilities (TBD)

1. The Music Queue in the zone group that was formed by the Zone Scene will be empty. In other words – the music will stop in any room that is part of the Zone Scene. This is the simplest solution, but may lead to frustration.
2. The user gets to choose from which of the 'joining' Queues the new zone group should play. This could be in the form of a dialog:

**What should the new Zone Group play?**

No Music

Track 1

Track 2

Radio Station A

Note that this method would only be useful (and possible) with simple Zone Scene grouping. With Advanced Zone Scene groupings, this dialog would become much too complicated.

3. In the case where only one of the zones in the new group was playing music, the new group should take the music (and Queue) of that zone.

SONOS-SVG2—00167534 at 167537.

419. However, there are actually four possibilities for actions when a speaker is added to a group, not three. A person of skill in the art would have found it obvious to choose from one of these possibilities—stop music, choose music, adopt the music of the only playing speaker, and continue playing the “standalone” music—when adding a speaker to a group. These are a limited number of obvious design options.

#### (c) Obviousness – Millington

420. Further, as discussed above, a person of skill in the art would have been motivated to combine the Sonos System with Millington. They are both in the same field of endeavor—control of speaker systems, speaker groups, synchronous playback of speakers, and home audio systems—and they both describe the same features and devices (*e.g.*, “zone players”) in the same



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language. Further, a person of skill in the art looking to the Sonos System would have also reviewed materials authored by one of the engineers, like Mr. Millington, that was working on the Sonos System to learn more about its capabilities.

421. Millington discloses “synchrony groups,” which correspond to the zone groups disclosed in the Sonos System. Millington notes that “[a] user, using the user interface module 13, can enable a zone player 1 l(n) that is currently not a member of a synchrony group to join a synchrony group, *after which it will be enabled to play the audio program that is currently being played by that synchrony group.*” Millington at 7 (emphasis added); *see also id.* at 9 (“Contemporaneously, the zone player 1 l(n) can notify the master device of the synchrony group that it (that is, zone player 1 l(n)) is joining, after which the master device can begin transmission of audio information and timing information to that zone player 1 l(n). The zone player 1 l(n) can thereafter begin playback of the audio program defined by the audio information, in accordance with the timing information so that the zone player 1 l(n) will play the audio program in synchrony with the master device.”); *id.* at 41 (“The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.”). Accordingly, Millington discloses that even when a zone player is added to a zone group (i.e., synchrony group), that it is only *enabled* to play the audio program playing in the synchrony group, but it does not necessarily play that audio immediately. Instead, the zone player must later transition to synchronous playback, as the claims require.

422. Millington further discloses keeping a media player in standalone mode after joining a group, because players disclosed by Millington continue to operate independently of the newly joined group. Millington at 7 (“As another possibility, the user may enable the zone player 1 l(1) to leave the synchrony group with zone player 1 l(2) and join the synchrony group with zone player 1 l(6). In connection with the last possibility, the zone player 1 l(1) can continue providing

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audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.”).

423. Millington discloses that speakers may be enabled to play back music in a group when they join that group, but do not necessarily do so. *Id.* (“A user, using the user interface module 13, can enable a zone player 11(n) that is currently not a member of a synchrony group to join a synchrony group, after which it will be enabled to play the audio program that is currently being played by that synchrony group.”).

**(d) Obviousness - Rajapakse**

424. It would have been obvious to combine Rajapakse with Sonos System for the reasons discussed above. As discussed below, Rajapakse discloses this claim limitation.

425. Rajapakse discloses keeping speakers in a standalone mode. Rajapakse at 14:37-40 (“Also it is possible to have the media renderers in no specific zone, which can be considered as equivalent to the media renderers being in zone 0 or a default zone.”).

426. Rajapakse discloses that after being added to a zone, the media renderer (speaker) may be playing or idle, so it may not be invoked by any zone (i.e., in standalone mode). Rajapakse at 7:52-56 (“The identity information includes the media renderer's identifier, its set of assigned zone identifiers (ZIDs), and its role within each zone, and known default stream identifiers for each zone. The current state information includes its current playing state: playing or idle.”). Sonos described “standalone mode” this way in its summary judgment brief, as discussed above.

427. Rajapakse discloses dynamic grouping and transitioning speakers among groups. Rajapakse at 3:65-4:2 (“If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.”).

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428. Rajapakse also discloses that the user may select which zone to invoke from many different zones. Rajapakse at 8:34-40 (“After zone manager discovery 602, the zone control point 209 retrieves zone information from each zone manager 210 and the zone control point 209 then uses this information to select a zone from the available set of zones. This selection may be an auto selection from the available zones (ZIDs) based on some preset criteria, such as signal strength, or based on user selection. . . . This process allows the user and zone control point 209 to get information on the zone, view media available to play on the zone and then make a selection.”).

429. Rajapakse discloses transitioning from one zone to another or transitioning from not playing music to playing music. Rajapakse at 8:67-9:2 (“If a new zone control point 209 requests the zone, the previous zone control point 209 can release the reservation.”).

430. Rajapakse discloses transitioning from one zone manager to another. Rajapakse at 9:35-44 (“If a media renderer 203 is already registered with another zone manager when the registration request comes in, and the registration request passes authentication, before responding, the media renderer 203 will notify 707 its current zone manager of the registration request from the new zone manager and ask for permission to deregister. If the current zone manager does not respond to this deregistration request within a timeout period, the media renderer 203 will assume approval and accept the new registration request from the new zone manager.”).

431. Rajapakse discloses forcing a transition of a media renderer from one zone to another. Rajapakse at 9:57-59 (“The user may, via the zone control point 209, cause the zone manager 210 to send a force registration 703 request to a media renderer.”).

**(e) Obviousness - Lindemann**

432. It would have been obvious to combine Lindemann with Sonos System for the reasons discussed above. As discussed below, Lindemann discloses this claim limitation.

433. Lindemann discloses selectively activating the speaker based on group

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membership, before or after that speaker was joined to a group. Lindemann at Cl. 9 (“9. The speaker of claim 2, further comprising means, responsive to a control signal in the status data for assigning the speaker to a speaker group, for selectively activating the speaker based on the speaker group to which the speaker is assigned.”).

**(f) Obviousness – Squeezebox**

434. For the reasons discussed above e.g., with respect to Limitation 1.7, it would have been obvious to combine the Sonos System with Squeezebox. As Mr. Lambourne testified, he was aware of Squeezebox given its competitive nature with the Sonos System. *Supra*. Others including reviewers recognized Sonos System as a competitor of Squeezebox. *Supra*. As such, a person of skill in the art, just like the inventor of the patent, would have been motivated to look to Squeezebox and combine aspects of the two systems. And as discussed below, Squeezebox discloses this claim limitation. And as discussed below e.g. in Section IX.B, Squeezebox discloses this claim limitation.

**(g) Obviousness – Sonos Forums**

435. It would also have been obvious to modify the Sonos System with Sonos Forums to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.6. For example, the Sonos Forums described *supra* (and fully incorporated herein by reference), disclose adding the first zone player to a first and a second zone scene as discussed with respect to Limitations 1.6 and 1.7. The Sonos Forums indicate that the players may continue to operate in their prior mode (standalone mode) until one of the zone scenes has been selected for invocation, as illustrated by the examples provided in the Sonos Forums. For example, the Sonos Forums illustrate that multiple zone scenes may be created, including overlapping zone players, and the Forums show that this system is workable such that the mere creation of a second group would not change the behavior of the speakers. In the instance where a summer and winter

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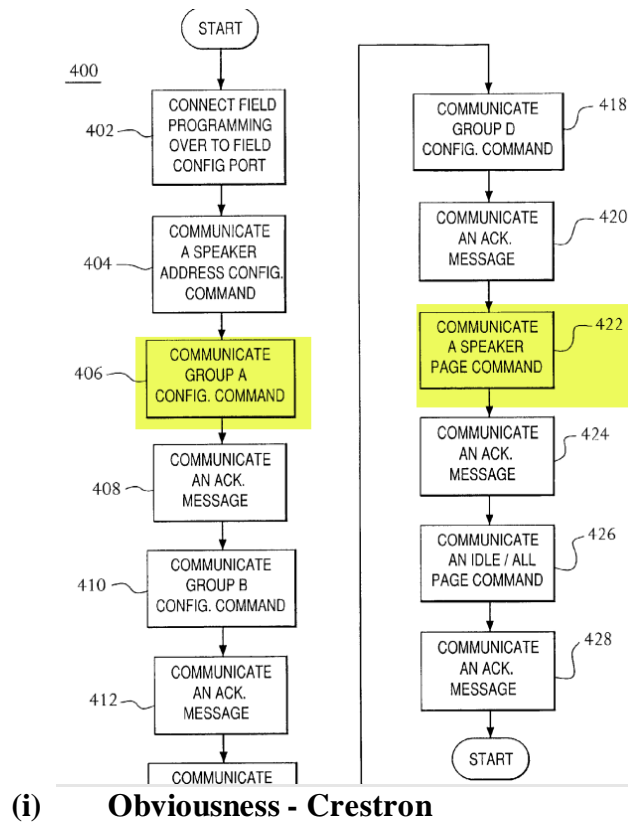
party mode are created, for example, the user creating the second seasonable group would not change the season, and therefore the zone player would remain in the prior grouping (or ungrouped) standalone state; without a change based only on being added to a new zone scene.

**(h) Obviousness – Nourse**

436. It would have been obvious to combine Nourse with Sonos System for the reasons discussed above.

437. Nourse also discloses the ability for a speaker to operate independently even after being added to a zone scene, as described in the Court’s Order. *See, e.g.*, 4:53-55 (“remote units 130 each monitor the incoming message from the master unit 102 to determine whether it is being addressed either as an individual unit or as part of a group”). This is disclosed in Nourse, for example in relation to Figure 4, reproduced below, where at step 406 “the field programming device communicates the Speaker Group A configured command to the remote unit 130” and later, while remote unit 130 is still in Group 1, “at step 422, the field programming device communicates a Speaker Page configure command to the remote unit 130.” Nourse at 7:37-39, 8:19-20.

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438. It would have been obvious to combine Crestron with Sonos System for the reasons discussed above. As I addressed above in relation to Limitation 1.6, it would have been obvious to modify the Sonos System with Crestron to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.6.

439. For example, Crestron also offered multi-room audio systems including speaker grouping and naming. For example, as shown below in a manual dated November 2005 and copyrighted 2005, Crestron offered multi-room audio. The system supported up to 24 rooms where listeners in each room could “listen selectively” to different audio sources. The system was plug-and-play compatible with Crestron’s iPod connector, called “iPod Connect.” Further, the system supported “Room Groups,” which made “it simple to combine speakers in adjacent rooms, or switch into whole-house party mode, by letting the user link any number of rooms to function as one,” but also let “listeners in each room ... listen selectively to any of 10 different stereo



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sources.” The system manual below did not provide other limitations on grouping.

## Crestron Adagio™ AES

### Entertainment System



The Adagio AES Entertainment System delivers a complete, cost-effective solution for high-performance multi-room audio distribution. Right out of the box, the AES provides sophisticated audio signal routing, processing, and amplification for up to 6 rooms, with extensive control from an enhanced LCD-driven front panel and a choice of room controllers.

**Multi-Room Audio**—The AES supports up to 6 sets of stereo room speakers, allowing listeners in each room to listen selectively to any of 10 different stereo sources. Its integrated multi-channel power amplifier delivers a robust 45 watts per channel to all rooms. Without requiring any programming, the AES can easily be expanded to support a total of 12 rooms by adding an AAE Audio Expander. Or, as many as 24 rooms can be handled using 3 AAE's with simple setup provided by Crestron Adagio Composer software.

**Enhanced Front Panel Control**—With its large backlit LCD display, Room and Group select buttons, 4 softkeys and dual rotary encoders, the AES front panel provides a very powerful, yet friendly user interface for controlling audio to a houseful of speakers. Custom naming of rooms, groups, and sources is facilitated on the LCD display, and also on the label strip using Crestron Engraver software.

**Room Groups**—The “Group” feature makes it simple to combine speakers in adjacent rooms, or switch into whole-house party mode, by letting the user link any number of rooms to function as one. Grouping lets you easily route one source to multiple rooms at once without the sync problems common to streaming-based systems. Up to 6 groups can be defined using the front panel Group buttons.

**Home Automation and Integration**—More than just an audio distribution system, the AES can actually grow as part of a complete home automation solution supporting all of Crestron's Cresnet and infiNET controllable dimmers, shade controllers, thermostats, and so much more.

- > Out-of-the-box audio distribution for 6 rooms, expandable up to 24
- > Enhanced front panel setup and control
- > Choice of 12-button room keypads or APAD LCD controllers
- > Optional AM/FM, XM and Sirius Satellite Radio tuner cards
- > Plug-and-play support for Adagio Audio Server and iPod Connect
- > 2-Series Ethernet control system — programmable to support Crestron touchpanels, wireless remotes, lighting dimmers, thermostats, and much more!

**SPECIFICATIONS**

**Processor**

### Controls and LED Indicators

**STANDBY:** Pushbutton with green LED, turns off power amplifier

**MUTE:** Pushbutton with green LED, mutes audio in selected room or group

**MODE:** (8) Pushbuttons, select mode for adjustment: SOURCE, ROOM, HOUSE, MENU, BKL, SCHED, DISPLAY, MORE (refer to manual)

**SOFTKEYS:** (4) LCD display-driven pushbuttons, select/activate various functions

**ROOM:** (6) Pushbuttons with green LEDs, labelling strip, select room to adjust

**GROUP:** (6) Pushbuttons with green LEDs, labelling strip, select group to adjust

**FUNCTION:** Continuous turn rotary encoder with adjoining “Select” pushbutton with green LED, for selecting and executing functions

**VOLUME:** Continuous turn rotary encoder, adjusts volume of selected room or group

**HW-R:** Hardware reset button recessed behind label strip, reboots the control system

**SW-R:** Software reset button recessed behind label strip, restarts the SIMPL program

<https://manualzz.com/doc/2220267/crestron-adagio%E2%84%A2-aes>; [see also](#)

[https://www.crestron.com/getmedia/aba893ef-04c0-493a-88dc-4ed7d365b8ac/mg\\_ams\\_1](https://www.crestron.com/getmedia/aba893ef-04c0-493a-88dc-4ed7d365b8ac/mg_ams_1) [at 2, 3,](#)

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## Configure Preset Groups <sup>I</sup>

Preset groups can be created to group speakers in adjacent rooms with a specified source, or switch into a whole-house “party” mode, by letting the user link a source with any number of rooms. Changing the source in any one room changes the source in all of the rooms in the preset group.

To edit a preset group:

- Press the **ROOM** button to enter the *Room* mode.
- Press the **MORE** button.
- Press the soft button labeled **Groups** to display the list of groups.
- Turn the selection knob to highlight the group to be configured and press the soft button labeled **Setup**. The Edit Group control will be displayed.

### Edit Group Control

The diagram illustrates the 'Edit Group Control' interface. It features a central LCD screen displaying the title 'Edit Group 3' and three lines of text: 'Source: No Source Selected', 'Name: Read', and 'Theater: Not Included'. To the left of the screen are four buttons labeled SOURCE, ROOM, HOUSE, and MENU. To the right are four buttons labeled SURRND, THEATER, DISPLAY, and MORE. Below the screen, there are four vertical bars corresponding to the labels Source, Name, Theater, and Done.

- Select the rooms in the preset group by pressing the corresponding room buttons on the AES or AAE (if connected). Each room button’s LED will turn on. Press again to remove the room from the preset group. The room button’s LED will turn off.
- Select a source for the preset group by pressing the soft button labeled **Source**. Turn the selection knob clockwise or counterclockwise until the desired source is displayed on the LCD and press the soft button labeled **Done**.
- Press the soft button labeled **Name** to change the name of the preset group. The group name controls will be displayed. Select letters (upper and lower-case) by turning the selection knob until the desired letter is displayed. Move the cursor to another position by pressing the soft buttons labeled **◀** and **▶**. To delete a character, press the soft button labeled **Del**.

**NOTE:** The maximum length for any preset group name is 16 characters.

- The theater room can be included in the group or excluded. To set the theater room’s inclusion, press the soft button labeled **Theater**.
- After editing the preset group, press **Done** to save the changes and return to the Groups listing.

11. **Limitation 1.9:** “after the given one of the first and second zone scenes has been selected for invocation, receiving, from the network device

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**over the data network, an instruction to operate in accordance with a given one of the first and second zone scenes respectively comprising a given one of the first and second predefined groupings of zone players; and”**

440. In my opinion, the Sonos System discloses this claim limitation.

441. In the Sonos System, a user may select a zone group for playback using the “Zones pane” and the playback controls to cause the Zone Players to operate as a synchronous playback group, as described below in the Sonos System user manual. The user may select the Zone Player or group in the “zones pane” on the lefthand side using the desktop controller (shown below) or the handheld controller CR100. The desktop controller or handheld controller provides an instruction to the Zone Players to operate in accordance with those saved groups (“zone scenes”) to synchronously play back media. The groups include user defined groups as discussed *supra* as well as groups that are provided by the Sonos System, such as “Party Mode,” which may play music synchronously through all the Zone Players in the system.

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You can select an action using the following method(s):

- Click the appropriate action button
- Select an action from the Menu bar
- Highlight a selection and then right-click

## Playback Controls

The **Now Playing** pane displays track information for the music you are currently listening to. You can control the music settings for the current selection using the playback controls below:



### Play/Pause

Toggles between playing and pausing the current track.



### Next (single-click)

Click **Next** to jump to the start of the next track in the queue.



### Fast forward (long press)

Click and hold down the **Next** button, or click and drag the progress bar to move forward through the current track. The music playback jumps to the new position when the button is released (while you are seeking, the song continues to play at the normal rate.) When the play indicator reaches the end of the track, play stops.

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**Managing Your Zones**

The **Zones** pane allows you to view the music currently playing in any zone in your house. You can play a different song in each zone, or you can group zones together to play the same music when you are having a party or anytime you want the same music selection to play in more than one room. Zones can be managed from either the **Zones** pane or the **Zones** menu. From either of these, you can:

- See an alphabetical list of the zones in your house
- Link zones together to form a zone group
- Drop a zone from a zone group


**Zone groups**

A zone can be grouped together with any other zone(s) to form a zone group. This will cause all the zones in the zone group to play the same music. You can link or drop zones from a zone group while the music is playing. You can also link all the ZonePlayers in your house with one touch by selecting **All Zones-Party Mode**.

**To select from your music library**

1. From the **Zones** pane, click to highlight the zone you want to play music in.
2. Choose one of the following options:
  - From the **Music Library** pane, click the **Library** tab.

Or,

- From the **Music** menu, click **Music Library**.
3. Use the mouse to move through the list until you reach the choice you want. To play all songs by an artist, on an album, or in a genre, highlight the selection and click **Play Now** to play the music now, or **Add to Queue** to add it to the end of your music queue. Click  to expand the music tree for any selection.

If you've created Sonos playlists (music queues you have saved), you can browse these playlists using the **Sonos Playlists** tab. See "Sonos Playlists" on page 3-17 for more information.

Lambourne Dep. Ex. 1077 at 25-33.

442. For example, the first Zone Player receives a SetAVTransportURI SOAP action with a Rincon group URI that meets the claimed "indication" and identifies the group to join (selected joinee group). However, the SetAVTransportURI message may be understood and/or it would have been obvious to parse that message into two separate messages: (a) a first message to notify zone players that they have joined a zone group and identify the group coordinator (meeting the indication limitations); and (b) a second message that provides the remote channel source (typically the group coordinator) and thus provides an instruction that results in synchronous playback (the present instruction limitation). To the extent that this would be a modification of

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the Sonos System, it would have been obvious to a POSITA because it allows greater flexibility in assigning and updating group coordinators and channel sources.

443. Further, the Rincon Group URI is the Now Playing URI that was sent by the controller. The Rincon Group URI has the form “x-rincon:<GROUP COORDINATOR UUID>,” which embeds a UUID identifying the Zone Player that is the group coordinator for the selected joinee group. Further, the network device sends a play and other transport control messages to the zone player for initiating and controlling playback. *See, e.g.:*

117. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 39–83 at 58, 60, 61, 66, 67, 80

118. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

119. RAVTServer::SetAVTransportURIWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 85–106 at 96–98

120. RAVTMediaRenderer::SetAVTransportURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 58–136 at 87–89

121. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 423–492

#### (b) Obviousness – POSITA

444. For the reasons discussed above e.g., with respect to Limitation 1.6, it would have been obvious to combine the Sonos System with the knowledge of a POSITA, and a POSITA would have found it straightforward to use multiple messages to implement different actions and/or user requests. Doing so would have allowed a POSITA greater flexibility in assigning and updating group coordinators and channel sources. And as discussed above, Sonos System in combination with the knowledge of a POSITA discloses this claim limitation, at least because it would have been obvious to parse the Sonos System SetAVTransportURI message into two separate messages: (a) a first message to notify zone players that they have joined a zone group and identify the group coordinator (meeting the indication limitations); and (b) a second message



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that provides the remote channel source (typically the group coordinator) and thus provides an instruction that results in synchronous playback (the present instruction limitation).

**(c) Obviousness – Squeezebox**

445. For the reasons discussed above e.g. in relation to Limitation 1.7, it would have been obvious to combine the Sonos System with Squeezebox. And as discussed below in Section XI.B, Squeezebox discloses this claim limitation.

**(d) Obviousness – Sonos Forums**

446. It would also have been obvious to modify the Sonos System with Sonos Forums to add this claim limitation, to the extent it is not disclosed, for the same reasons discussed with respect to Limitation 1.6. For example, the Sonos Forums described *supra* (and fully incorporated herein by reference), disclose adding the first zone player to a first and a second zone scene as discussed with respect to Limitations 1.6 and 1.7. In order for a zone player to be part of two zone scenes or two groups at the same time, the zone scenes or zone groups must be able to be created separately from any invocation step. The Sonos Forums further disclose that one of the overlapping zone scenes may be selected for invocation and the zone player may be instructed to operate synchronously with the other zone players in the zone scene. Each of the Sonos Forums posts shows that the disclosed zone scenes can be created and exist separate from any invocation, and the Sonos Forums posts also show that the zone scenes are operable to output music synchronously, just as the Sonos System did, and that those zone scenes can be invoked.

**(e) Crestron**

447. As I addressed above in relation to Limitation 1.6, it would also have been obvious to modify the Sonos System with Crestron to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.6. This is at least because Crestron discloses that a speaker can be part of multiple groups, as I described *e.g.* in Section X

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(and incorporated herein by reference), and in order for a speaker to be part of two zone scenes or two groups at the same time, the zone scenes or zone groups must be able to be created separately from any invocation step.

**(f) Yamaha**

448. It would also have been obvious to modify the Sonos System with the Yamaha system to add this claim limitation, to the extent it is not disclosed. This is at least because Yamaha discloses that a speaker can be part of multiple groups, and in order for a speaker to be part of two zone scenes or two groups at the same time, the zone scenes or zone groups must be able to be created separately from any invocation step. In addition, a POSITA would have been motivated to combine Yamaha with the Sonos System at least because users of playback systems considered Yamaha as an alternative to the Sonos System. *See e.g.*, SONOS-SVG2-00032289, SONOS-SVG2-00033695, SONOS-SVG2-00053679. As I described *e.g.* in Section X (and incorporate herein by reference), the Yamaha system discloses conventional speaker grouping, including multiple speakers that could be grouped into areas, which could then be divided into zones, which could also be divided into device groups, with master and slave devices in those groups. *See e.g.*, DME Manual at 3. at 183. The DME system disclosed creating “scenes” that could be named, saved, and recalled, and included particular configurations and preset parameters and were used in conjunction with the areas and zones. *See e.g.*, DME Manual at 5-6, 25-26, 55.

- 12. Limitation 1.10: “based on the instruction, transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players such that the first zone player is configured to coordinate with at least one other zone player in the given one of the first and second predefined groupings of zone players over a data network in order to output media**

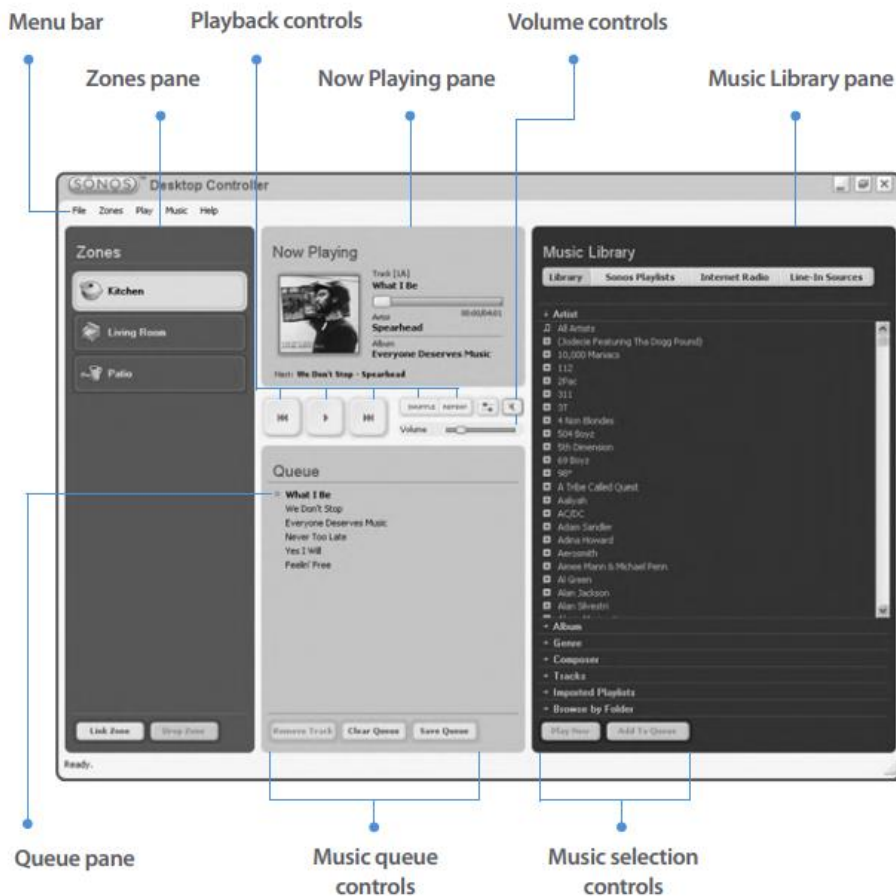
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**in synchrony with output of media by the at least one other zone player in the given one of the first and second predefined groupings of zone players.”**

449. In my opinion, the Sonos System discloses this claim limitation.

450. As described in the previous claim limitation, a user may select a zone group for playback using the “Zones pane” and the playback controls to cause the Zone Players to operate as a synchronous playback group, as described below in the Sonos System user manual. The user may select the Zone Player or group in the “zones pane” on the left hand side using the desktop controller (shown below) or the handheld controller CR100. The desktop controller or handheld controller provides an instruction to the Zone Players to operate in accordance with those saved groups (“zone scenes”) to synchronously play back media. The groups include user defined groups as discussed *supra* as well as groups that are provided by the Sonos System, such as “Party Mode,” which may play music synchronously through all the Zone Players in the system. The Zone Players will then coordinate with each other to attempt to provide synchronous playback of media.

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You can select an action using the following method(s):

- Click the appropriate action button
- Select an action from the Menu bar
- Highlight a selection and then right-click

## Playback Controls

The **Now Playing** pane displays track information for the music you are currently listening to. You can control the music settings for the current selection using the playback controls below:



### Play/Pause

Toggles between playing and pausing the current track.



### Next (single-click)

Click **Next** to jump to the start of the next track in the queue.



### Fast forward (long press)

Click and hold down the **Next** button, or click and drag the progress bar to move forward through the current track. The music playback jumps to the new position when the button is released (while you are seeking, the song continues to play at the normal rate.) When the play indicator reaches the end of the track, play stops.

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## Managing Your Zones

The **Zones** pane allows you to view the music currently playing in any zone in your house. You can play a different song in each zone, or you can group zones together to play the same music when you are having a party or anytime you want the same music selection to play in more than one room. Zones can be managed from either the **Zones** pane or the **Zones** menu. From either of these, you can:

- See an alphabetical list of the zones in your house
- Link zones together to form a zone group
- Drop a zone from a zone group


### Zone groups

A zone can be grouped together with any other zone(s) to form a zone group. This will cause all the zones in the zone group to play the same music. You can link or drop zones from a zone group while the music is playing. You can also link all the ZonePlayers in your house with one touch by selecting **All Zones-Party Mode**.

### To select from your music library

1. From the **Zones** pane, click to highlight the zone you want to play music in.
2. Choose one of the following options:
  - From the **Music Library** pane, click the **Library** tab.

Or,

- From the **Music** menu, click **Music Library**.
3. Use the mouse to move through the list until you reach the choice you want. To play all songs by an artist, on an album, or in a genre, highlight the selection and click **Play Now** to play the music now, or **Add to Queue** to add it to the end of your music queue. Click  to expand the music tree for any selection.

If you've created Sonos playlists (music queues you have saved), you can browse these playlists using the **Sonos Playlists** tab. See "Sonos Playlists" on page 3-17 for more information.

Lambourne Dep. Ex. 1077 at 25-33.

451. For example, the first Zone Player handles the SetAVTransportURI SOAP action by extracting the group coordinator's UUID from the URI, stopping the local channel sink, using the group coordinator's UUID to determine the Group Management control URI, requesting the group coordinator via the Group Management control URI to add the first Zone Player to its group, and setting up the local channel sink to listen to and play the group coordinator's channel source. The first Zone Player sends the AddMember SOAP action to the group coordinator to request addition to the group. *See, e.g.:*

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122. RAVTServer::dispatch(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 39–83 at 66, 80

123. dm2() macro, V1.2\v1.2-gold\oc\protocol\server\include\common\_server.h, 7

124. RAVTServer::SetAVTransportURIWrapper(), V1.2\v1.2-gold\oc\protocol\server\src\avt\_server.cxx, 85–106 at 96–98

125. RAVTMediaRenderer::SetAVTransportURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 58–136 at 87–89

126. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 423–492 at 428–430, 440, 443–447, 460–466

127. RGMZonePlayer::localConfigureGroup(), V1.2\v1.2-gold\oc\zp\gm\_impl.cxx, 460–590 at 525–526, 529, 532–536

128. RDeviceTopology::getGMControlURIFromRemoteUUID(), V1.2\v1.2-gold\oc\zp\topology.cxx, 1067–1089

129. RGMClient::AddMember(), V1.2\v1.2-gold\oc\protocol\client\src\gm\_client.cxx, 19–32

130. AddMember action, V1.2\v1.2-gold\cc\anacapa\anacapa\pkg\htdocs\xml\GroupManagement1.xml, 26–45

452. As part of setting up the local channel sink to listen to and play the group coordinator’s channel source, the Zone Player switches to the channel source as the Simple Network Time Protocol (SNTP) server for playback time monitoring. During playback, the channel sink uses the SNTP server to determine the clock offset from the server. The clock offset is used to adjust the actual play time. The channel sink also adjusts the digital-to-analog converter (DAC) clock speed to compensate for differences between the desired and actual play times. *See, e.g.:*

131. RAVTMediaRenderer::setTransportToRinconGroupURI(), V1.2\v1.2-gold\oc\zp\avt\_impl.cxx, 423–492 at 466

132. RChannelSink::changeToRemoteSourceAndPlay(), V1.2\v1.2-gold\oc\zp\chsnk.cxx, 309–337 at 315–318



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133. RChannelSink::setRemoteTransportSettings(), V1.2\1.2-gold\oc\zp\chsnk.cxx, 663–695 at 679–680, 683–687, 689, 692

134. RChannelSourceTransportSettings::transportSettings(), V1.2\1.2-gold\oc\zp\srcbase.h, 47–56

135. RChannelSink::m\_Sntp, V1.2\1.2-gold\oc\zp\chsnk.h, 102–104

136. RChannelSink::notifySamples(), V1.2\1.2-gold\oc\zp\chsnk.cxx, 809–902 at 880–895

137. SntpPollThread::convertServerTimeToLocalTime(), V1.2\1.2-gold\oc\zp\sntppoll.cxx, 180–193

138. RChannelSink::monitorDACClock(), V1.2\1.2-gold\oc\zp\chsnk.cxx, 965–1016

139. RChannelSourceBase constructor, V1.2\1.2-gold\oc\zp\srcbase.cxx, 102–157

140. SntpServerThread::threadFuncInternal(), V1.2\1.2-gold\oc\zp\sntpsrv.cxx, 37–65 at 60

141. handleSntpRequest(), V1.2\1.2-gold\oc\zp\sntp.cxx, 336–366

**(b) Obviousness – POSITA**

453. For the reasons discussed above, it would have been obvious to combine the Sonos System with the knowledge of a POSITA. And as discussed above, Sonos System in combination with the knowledge of a POSITA discloses this claim limitation.

**(c) Obviousness – Squeezebox**

454. For the reasons discussed above, it would have been obvious to combine the Sonos System with Squeezebox. And as discussed below, Squeezebox discloses this claim limitation.

**(d) Obviousness – Sonos Forums**

455. It would also have been obvious to modify the Sonos System with Sonos Forums to add this claim limitation, to the extent it is not disclosed, for the same reasons discussed with respect to Limitation 1.6. For example, the Sonos Forums described *supra* (and fully incorporated herein by reference), disclose adding the first zone player to a first and a second zone scene as

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discussed with respect to Limitations 1.6 and 1.7. The Sonos Forums further disclose that one of the overlapping zone scenes may be selected for invocation and the zone player may be instructed to operate synchronously with the other zone players in the zone scene. The Sonos Forums further disclose that the zone player is transitioned from operating in standalone mode to operating synchronously with a zone scene. As users on the Sonos Forums requested, *supra*, users disclosed and sought a solution for a more dynamic system wherein overlapping zones could be variously invoked and the zone players within those zones would transition appropriately—for example from standalone mode to a mode wherein the zone player output audio synchronously with the other zone players in the zone scene.

**(e) Obviousness – Nourse**

456. As I addressed above in relation to Limitation 1.8, it would also have been obvious to modify the Sonos System with Nourse to add this claim limitation, to the extent it is not disclosed for the same reasons discussed with respect to Limitation 1.8.

**(f) Crestron**

457. As I addressed above in relation to Limitation 1.6, it would also have been obvious to modify the Sonos System with Crestron to add this claim limitation, to the extent it is not disclosed, for the same reasons discussed with respect to Limitation 1.6.

**(g) Yamaha**

458. It would also have been obvious to modify the Sonos System with the Yamaha system to add this claim limitation, to the extent it is not disclosed. This is at least because Yamaha discloses that a speaker can be part of multiple groups, and in order for a speaker to be part of two zone scenes or two groups at the same time, the zone scenes or zone groups must be able to be created separately from any invocation step. In addition, a POSITA would have been motivated to combine Yamaha with the Sonos System at least because users of playback systems considered

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Yamaha as an alternative to the Sonos System. *See e.g.*, SONOS-SVG2-00032289, SONOS-SVG2-00033695, SONOS-SVG2-00053679. As I described *e.g.* in Section X (and incorporate herein by reference), the Yamaha system discloses conventional speaker grouping, including multiple speakers that could be grouped into areas, which could then be divided into zones, which could also be divided into device groups, with master and slave devices in those groups. *See e.g.*, DME Manual at 3. at 183. The DME system disclosed creating “scenes” that could be named, saved, and recalled, and included particular configurations and preset parameters and were used in conjunction with the areas and zones. *See e.g.*, DME Manual at 5-6, 25-26, 55.

**B. Anticipation over and Obviousness In View of Squeezebox**

459. Squeezebox was publicly available, on sale, offered for sale, and described in printed publications both before the critical date (*i.e.*, prior to September 12, 2005), before the alleged conception date (*i.e.*, prior to December 21, 2005), and prior to the patent filing date on September 12, 2006. The features offered in that system were substantially the same during each of those time frames, as discussed below.

460. The capabilities and features of Squeezebox are apparent from source code available to the public, the products themselves, technical documentation that Logitech/Slim Devices has made available, public documentation regarding that system, professional and customer reviews, and other sources discussed below.

461. In my opinion, Claim 1 is anticipated and/or rendered obvious based on the Squeezebox in view of the general knowledge of a POSITA, and the references as described below. Below, I analyze each limitation of Claim 1 and demonstrate why that claim is invalid.

462. I discuss certain source code functionality of SlimServer and Squeezebox devices below. Here I offer background for those opinions.

463. Regarding the SlimServer configuration, the SlimServer program is written in Perl,

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disclosed by Squeezebox because it can or may not play back music, as shown above.

509. As shown above and discussed in more detail below, a Squeezebox or SoftSqueeze can play back media individually. There may be multiple Squeezeboxes or SoftSqueezes operating on the network at the same time. *E.g.*, IA at 74 (“Yes, you can have any number of Squeezeboxes on your LAN”), 99, 312.

**19. Limitation 1.6: “(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked; and”**

510. In my opinion, the Sonos System discloses this claim limitation.

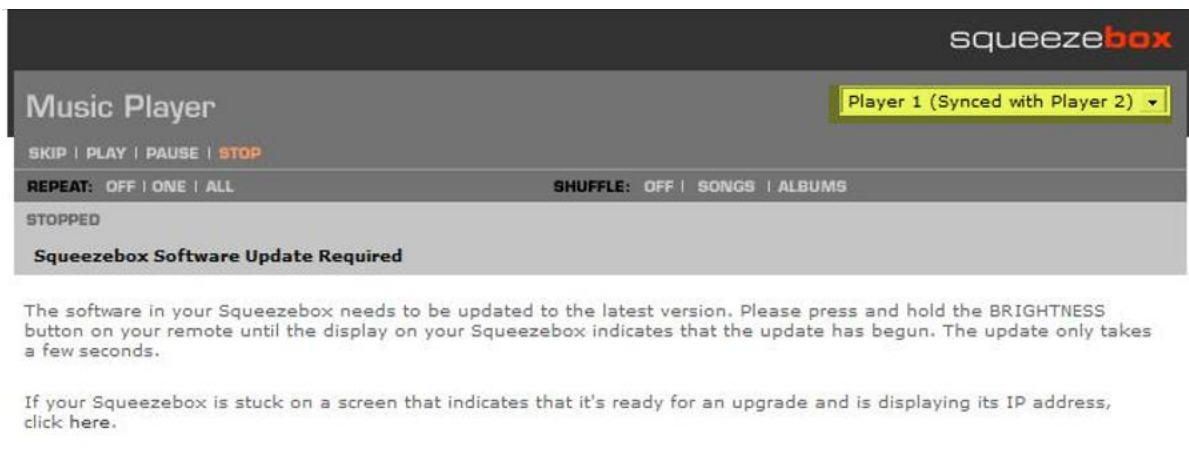
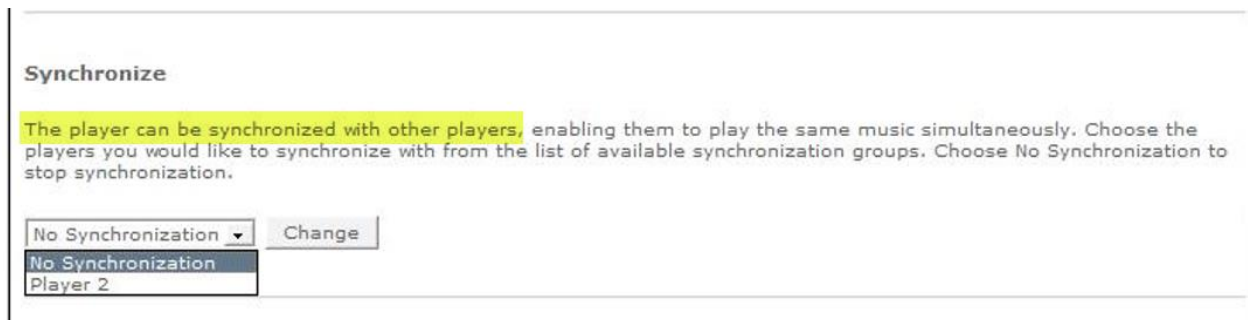
511. Sonos discussed this claim limitation, in part, in its summary judgment briefing. As I discussed *supra* in Section X, Sonos argued and the Court accepted that adding a speaker to a speaker group via a controller and sending an “indication” that need not include the “zone scene” or the players in that zone scene is sufficient to meet this claim limitation.

512. The user manual for Squeezebox 2 described controlling multiple Squeezeboxes by grouping them together. As one reviewer noted at the time, “Actually this is one nice feature of the Slimserver software. It enables you to group together a couple of players. Once done, the music can be controlled from each player (the other players react in sync), the only feature that works independently is volume control. And of course you can group / ungroup / regroup the players on the fly (from a Web interface or using a remote controller) . . . . So instead of having a complicated and limited system, there finally is a clean architecture to handle multiroom sound systems. Instead of miles of cables there is a WiFi cloud covering the music library server (in a basement) and all

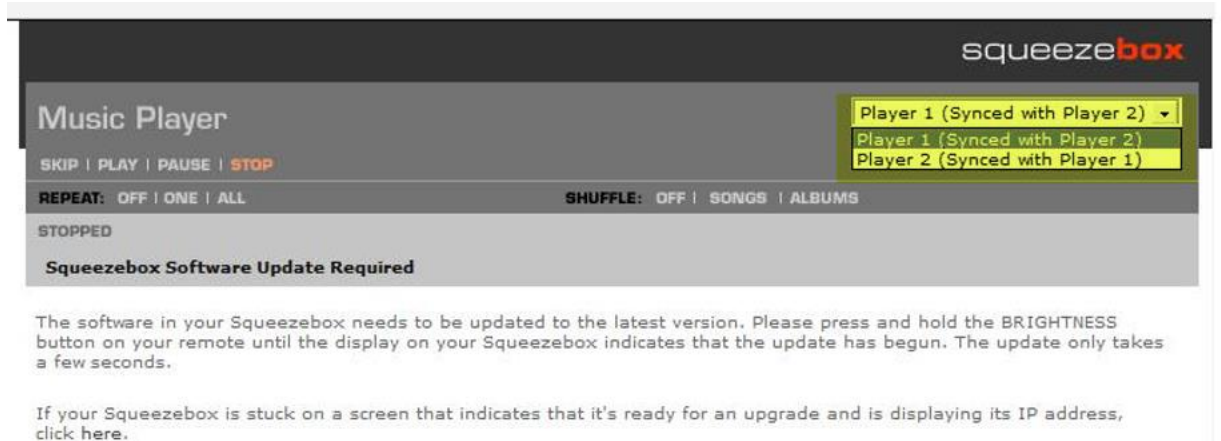
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players (in rooms). Rooms can be synchronized or independent, setup and especially using the system is very simple and intuitive.” GOOG-SONOSWDTX-00054659. This description matches the “zone scene” discussion in the Court’s Order, showing that the prior art Squeezebox system disclosed a set of previously-saved groups and “once done,” a user can later control each zone scene wherein the speakers in that zone scene will “react in sync.”

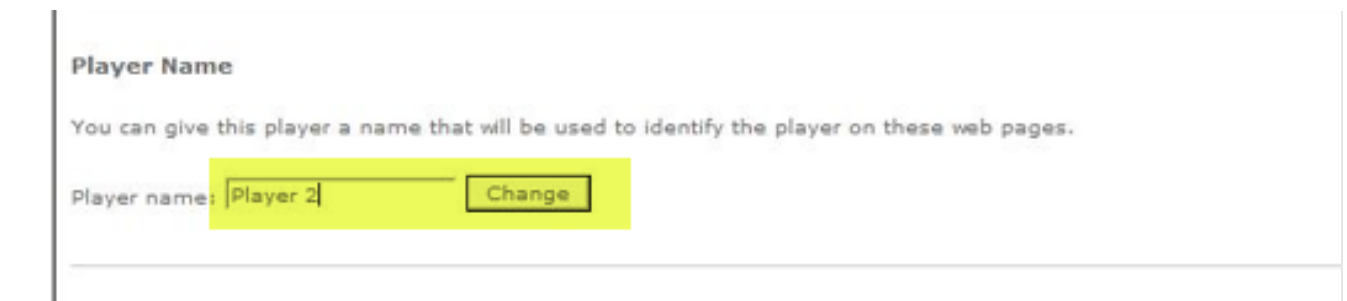
513. As shown in the annotated screenshots reproduced below, the SlimServer allowed a user to group together different players (*e.g.*, Player 1, Player 2) so that synchronous playback is performed.



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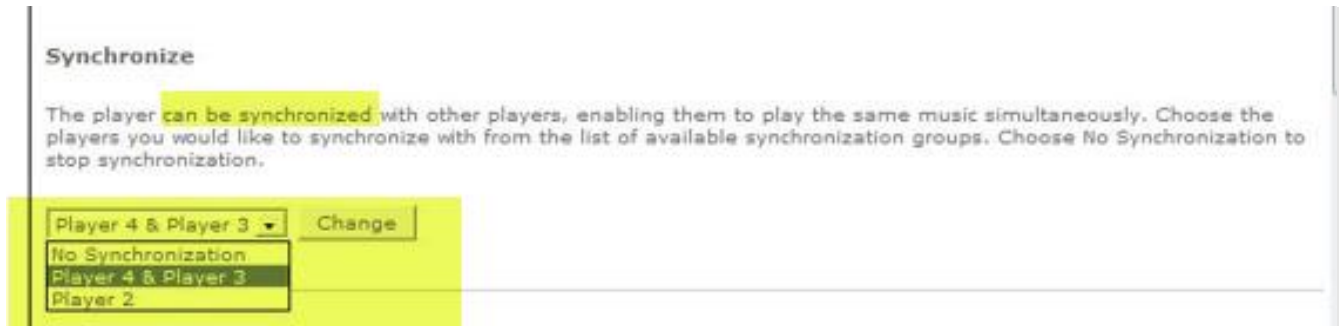


514. The user of the SlimServer could change the name and identifiers of the Squeezebox devices, which in turn changes the name of the grouped Squeezebox devices. This corresponds to the Court's Order, holding that the user can provide a name for the zone scene such that he or she may later interact with that zone scene. Depending on the names provided, the zone scene may or may not include a thematic name. The Squeezebox devices may be played individually or as a group, and the SlimServer allowed a user to change the synchronization groups after they have been created and stored—again allowing the user to pre-save customized speaker groups and later invoke those zone scenes.





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515. In my testing of the Logitech prior art system using a single SlimServer, I was able to setup a synchronization group (zone scene), and later invoke it. As shown below, I setup a first Squeezebox player (“Player1”) which was playing the song “Don’t Tempt Me,” and also had a second Squeezebox player (“Player3”) which was turned off. I then synchronized Player1 (playing “Don’t Tempt Me”) with Player 3 (which was off)—Player1 switched to playing nothing while Player3 remained off (Step 1 as shown below). In other words, Player 1 received an indication to join a group, and joined the group. This matches the Court’s Order, which provided that a user can create a zone scene with a name (here, including the identity of the players) and later play to speakers within that zone scene or invoke the zone scene itself.

516. The screenshots below show Player1 playing music, while Player3 remains off.

Player1:



Player3:

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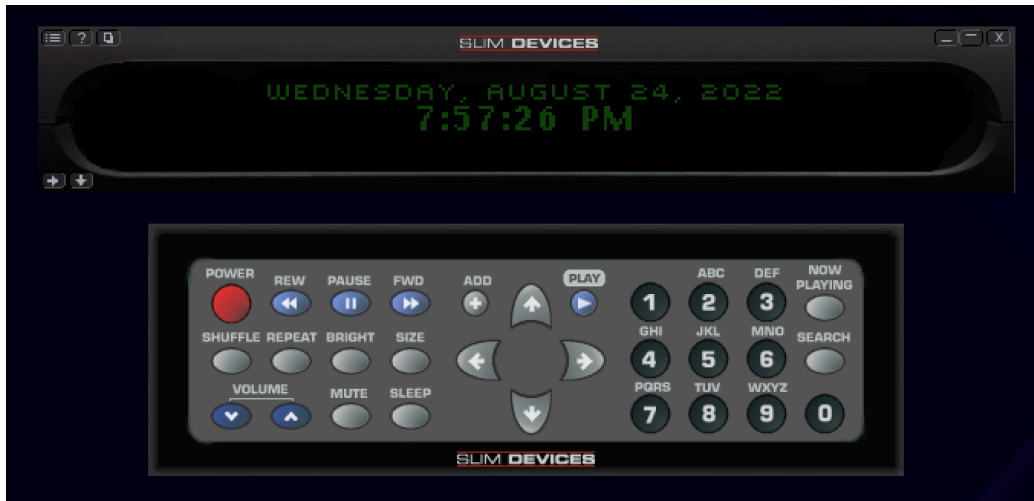
517. The screenshots below show that while Player1 is playing, Player1 is synchronized with Player3, and Player1 switches to playing nothing, while Player3 remains off. The slimserver2 preferences file also shows Player1 in a sync group (having Group ID 980703837) with Player3.

Player1:

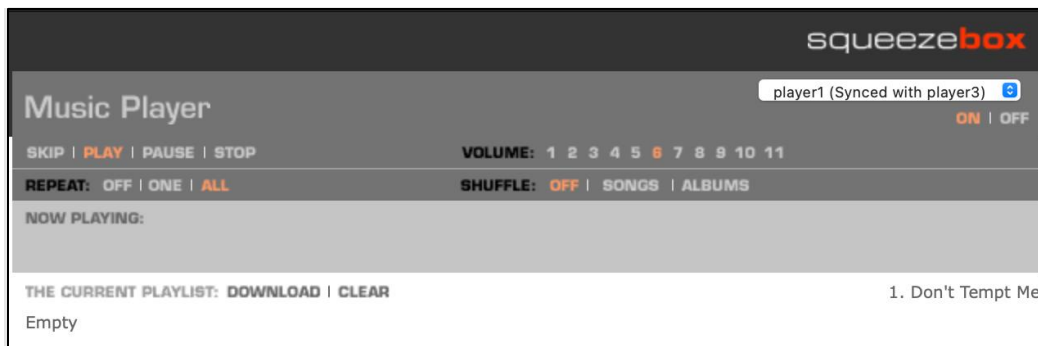


Player3:

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Web UI showing Player1 synchronized with Player3:



Server preference file:

```
[vmuser@slimserver2 ~]$ grep -P 'sync|playername|power\b' /etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
19:1e:67:04:72:30-syncVolume = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncVolume = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 980703837
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncVolume = 0
db:3a:52:e6:70:6b-syncgroupid = 980703837
```

518. After Step1, in which I synchronized Player 1 and Player 3, *i.e.*, created a group with Player1 and Player 3, I next chose to have Player1 play a new song “Jennie” on its own

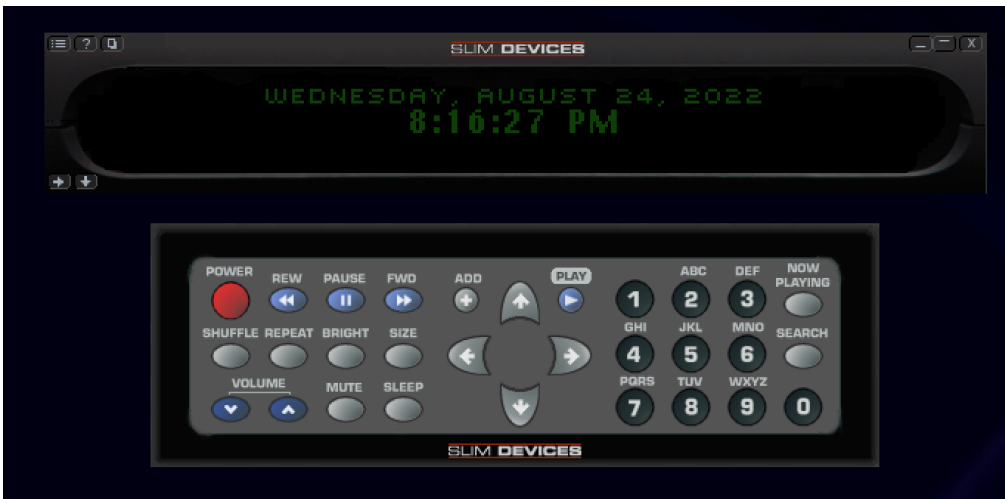
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(Player3 still being off). Throughout this process, the server (slimserver2)’s preferences file indicated Player1 was in a sync group with Player3, (with group ID 980703837). In other words, Player1 was still configured to play in standalone mode, even after it has joined the group previously setup in Step 1. Again, this is consistent with the Court’s Order, which establishes that although a group may be named and saved—and hence considered a zone scene—the group members may operate independently until the user “later invoke[s] the named groups on demand.”

Player1:



Player3:



Server Preferences File:

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```
[vmuser@slimserver2 ~]$ grep -P 'sync|playername|power\b' /etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
19:1e:67:04:72:30-syncVolume = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncVolume = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 980703837
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncVolume = 0
db:3a:52:e6:70:6b-syncgroupid = 980703837
```

519. While Player1 was still playing music individually, I was also able to “invoke” the Player1-Player 3 group, by selecting to play a different song on Player3, causing Player 3 to turn on, and both players 1 and 3 to play in synchrony, as shown in Step 3 below. Specifically, I selected to play “Gypsy Love Songs” on Player3, causing Player3 to power on and both Player1 and Player 3 to play “Gypsy Love Songs” in synchrony. The server (slimserver2)’s preference file shows Player1 is still in a sync group (Group ID 980703837) with Player3. In other words, after creating a group (Step 1), and having Player1 continue to play in standalone mode while being part of the group (Step 2), I was able to later “invoke” the group consisting of Player1 and Player 3, and have Player1 and Player3 play in synchrony. As discussed above, this behavior matches the Court’s Order with respect to zone scenes, as those zone scenes may be created and then only later “invoked,” which transitions speakers from acting independently to acting in accordance with the zone scene.

Player1:

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Player3:



Server:

```
[vmuser@slimserver2 ~]$ grep -P 'sync|playername|power\b' /etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
19:1e:67:04:72:30-syncVolume = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 1
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncVolume = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 980703837
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncVolume = 0
db:3a:52:e6:70:6b-syncgroupid = 980703837
```

520. Accordingly, I understand that with the Logitech prior art system, a user could both

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setup and later invoke “zone scenes,” with speakers having the ability to continue to operate in standalone mode in the interval between setup and invocation, as described in the Court’s Order.

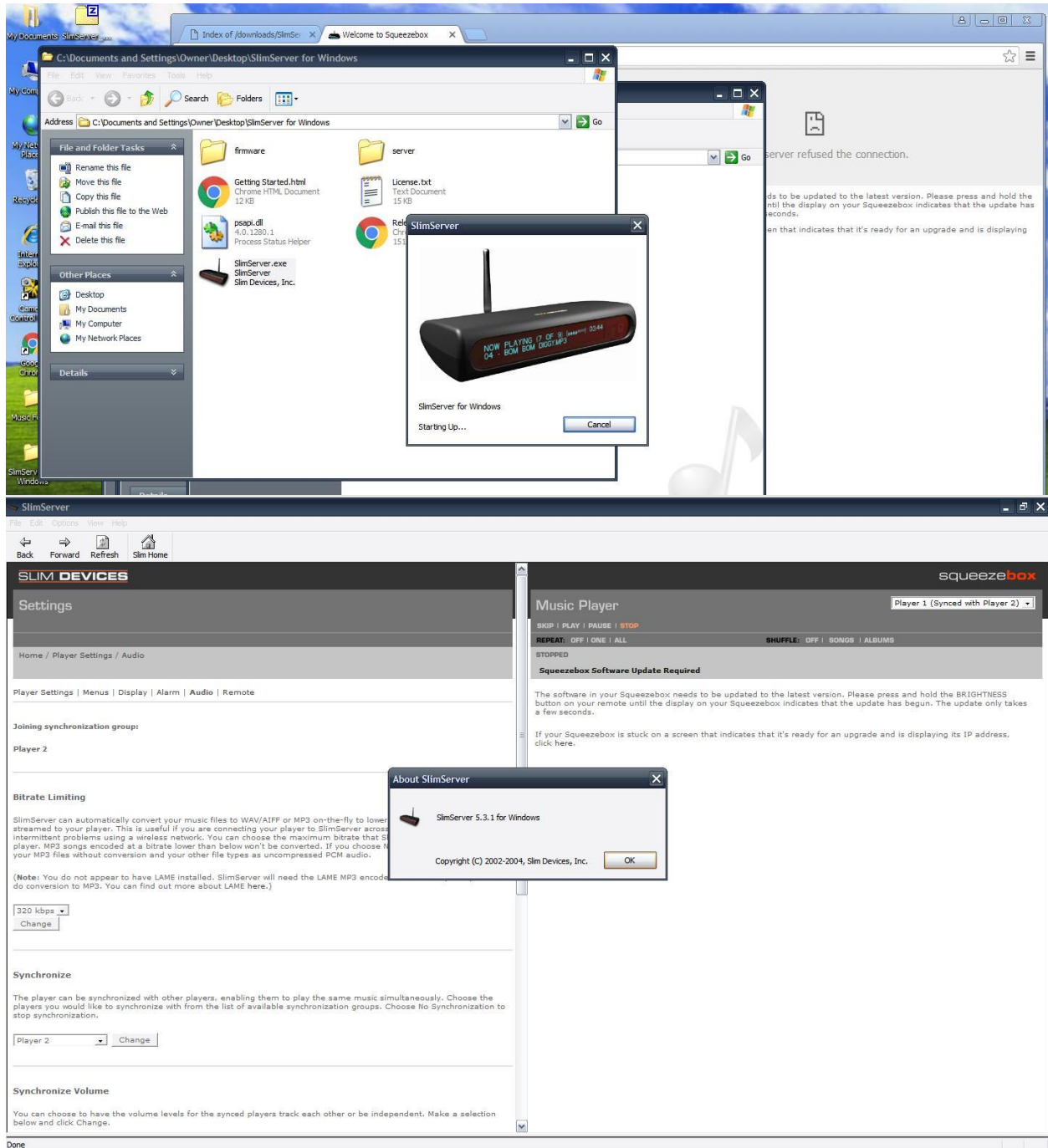
521. Further, this claim limitation requires the Squeezebox to receive information from a network device over a data network. The network device may comprise the SlimServer running on a computer, which allows a user to control Squeezeboxes remotely over Wi-Fi or wired data networks. Squeezebox receives a first indication in the form of network messages passed from the controller and that later permit the Squeezebox to synchronously playback media with other Squeezeboxes when the named group of Squeezeboxes is invoked by selecting that “zone scene” for synchronous playback.

522. I have provided below screenshots of certain testing performed on physical Squeezeboxes. This testing was performed on SlimServer version 5.3.1, which was available October 2004, and I have confirmed that other versions operate similarly. <https://downloads.slimdevices.com/>; [https://downloads.slimdevices.com/SlimServer\\_v5.3.1/](https://downloads.slimdevices.com/SlimServer_v5.3.1/). The testing was performed with a prior art laptop running prior art operating system software made available for inspection to Sonos.

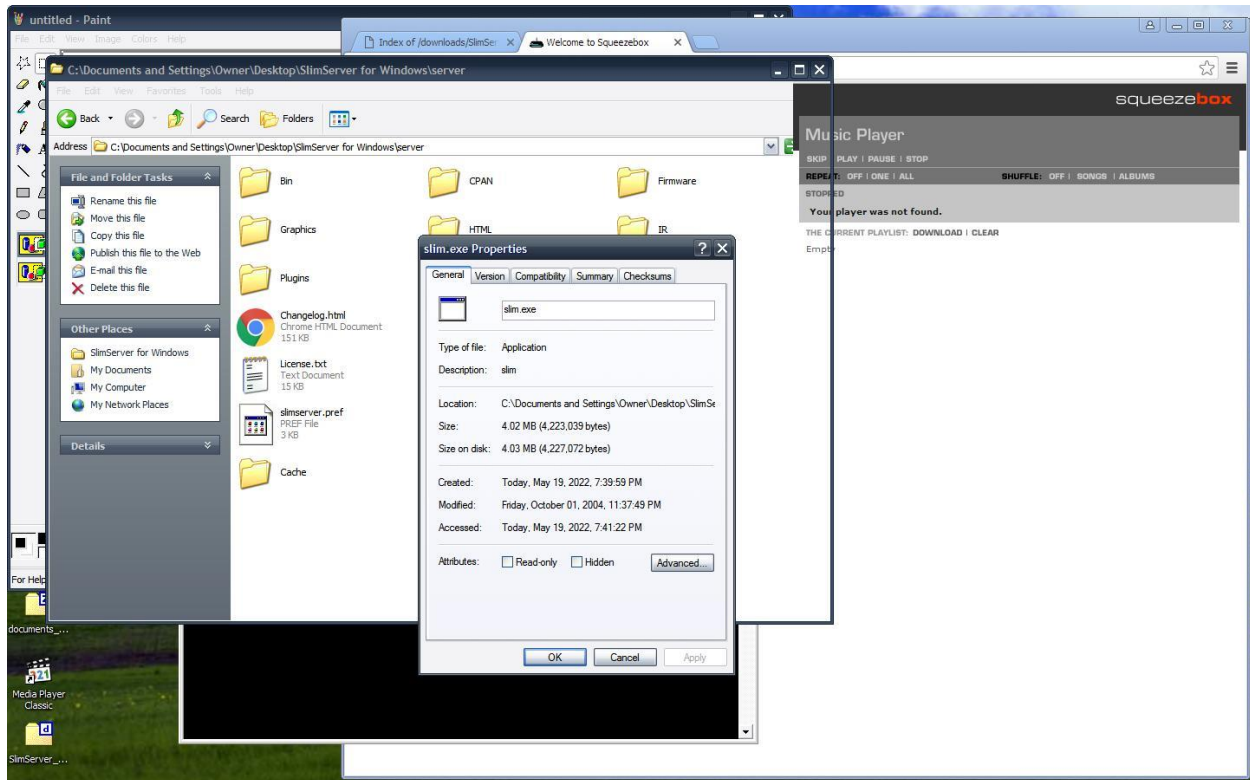
Name	Type	Compressed size	Password ...	Size	Ratio	Date modified
firmware	File folder					10/1/2004 2:37 PM
server	File folder					10/1/2004 2:37 PM
Getting Started.html	Chrome HTML Document	4 KB	No	12 KB	64%	10/1/2004 2:37 PM
License.txt	Text Document	6 KB	No	15 KB	62%	10/1/2004 2:37 PM
psapi.dll	Application extension	23 KB	No	45 KB	49%	10/1/2004 2:37 PM
Release Notes.html	Chrome HTML Document	49 KB	No	151 KB	68%	10/1/2004 2:37 PM
SlimServer.exe	Application	230 KB	No	512 KB	56%	10/1/2004 2:37 PM



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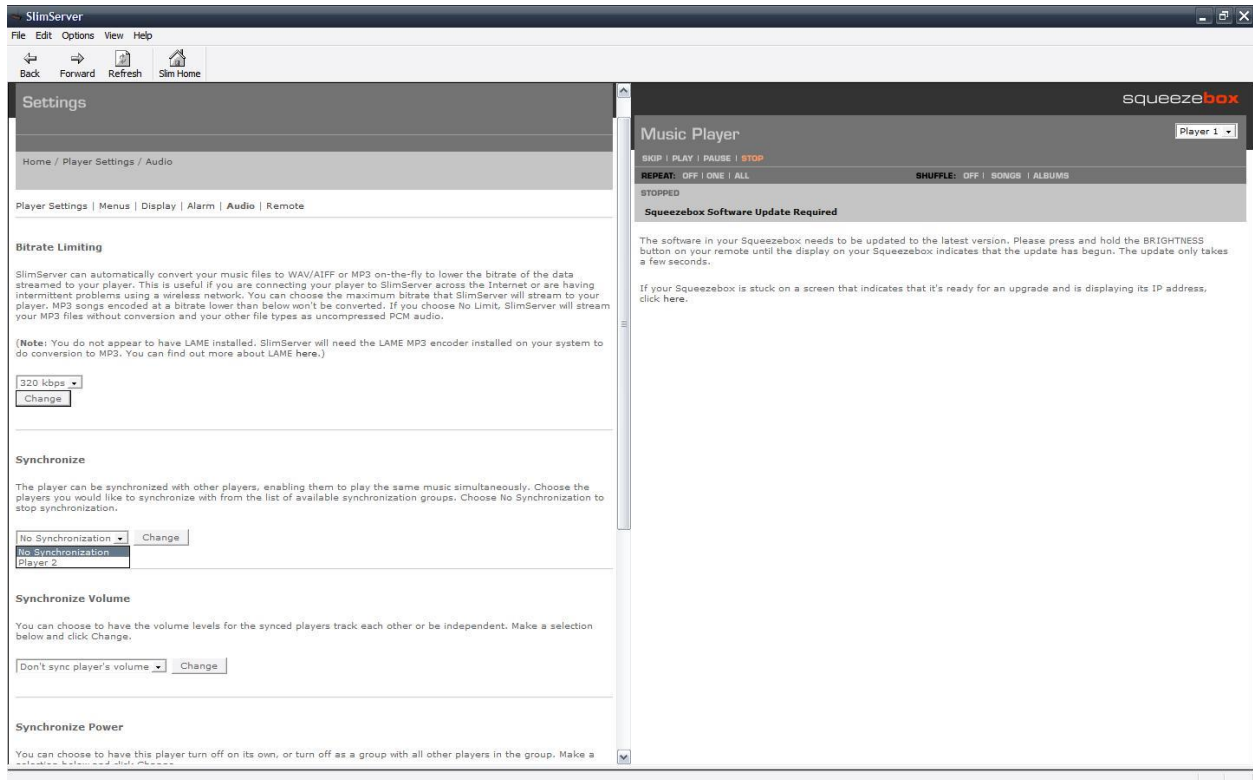
The linked image cannot be displayed. The file may have been moved, renamed, or deleted. Verify that the link points to the correct file and location.

523. I also installed the relevant software and performed testing using another prior art computer, which was a Dell XPS M140, which I understand counsel has produced and/or made available for inspection. <https://www.cnet.com/reviews/dell-xps-m140-review/>; <https://www.engadget.com/2005-10-26-dell-to-release-media-happy-xps-m140-and-dimension-e310-later.html>; [https://dl.dell.com/manuals/all-products/esuprt\\_laptop/esuprt\\_xps\\_laptop/xps-m140\\_owner's%20manual\\_en-us.pdf](https://dl.dell.com/manuals/all-products/esuprt_laptop/esuprt_xps_laptop/xps-m140_owner's%20manual_en-us.pdf). This prior art computer demonstrates the same capability

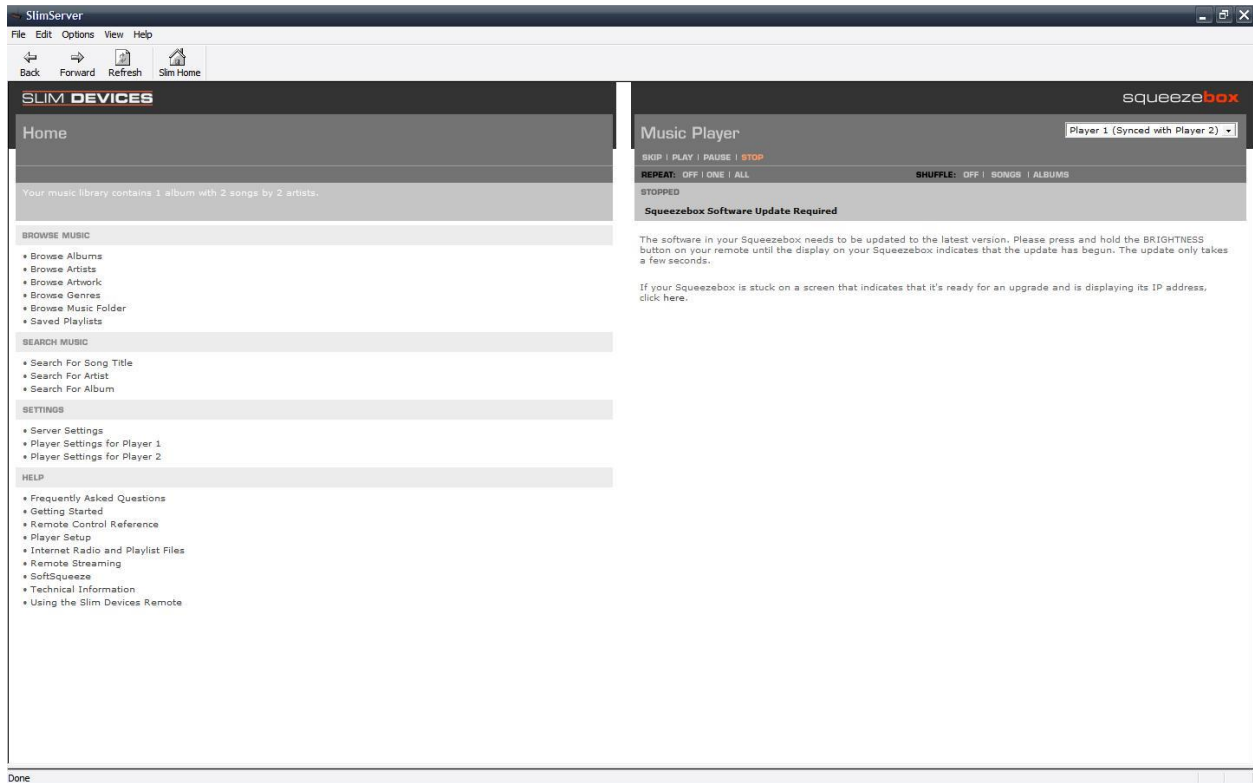
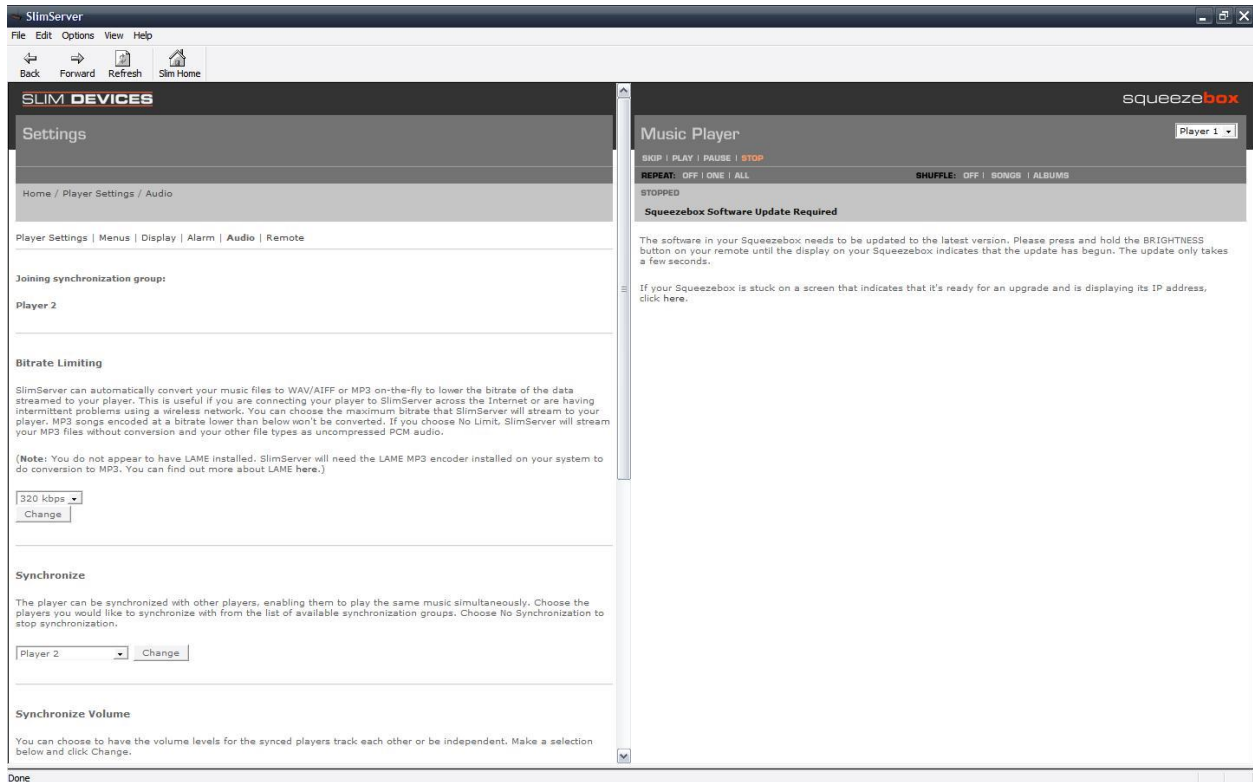
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as the Lenovo prior art machine.

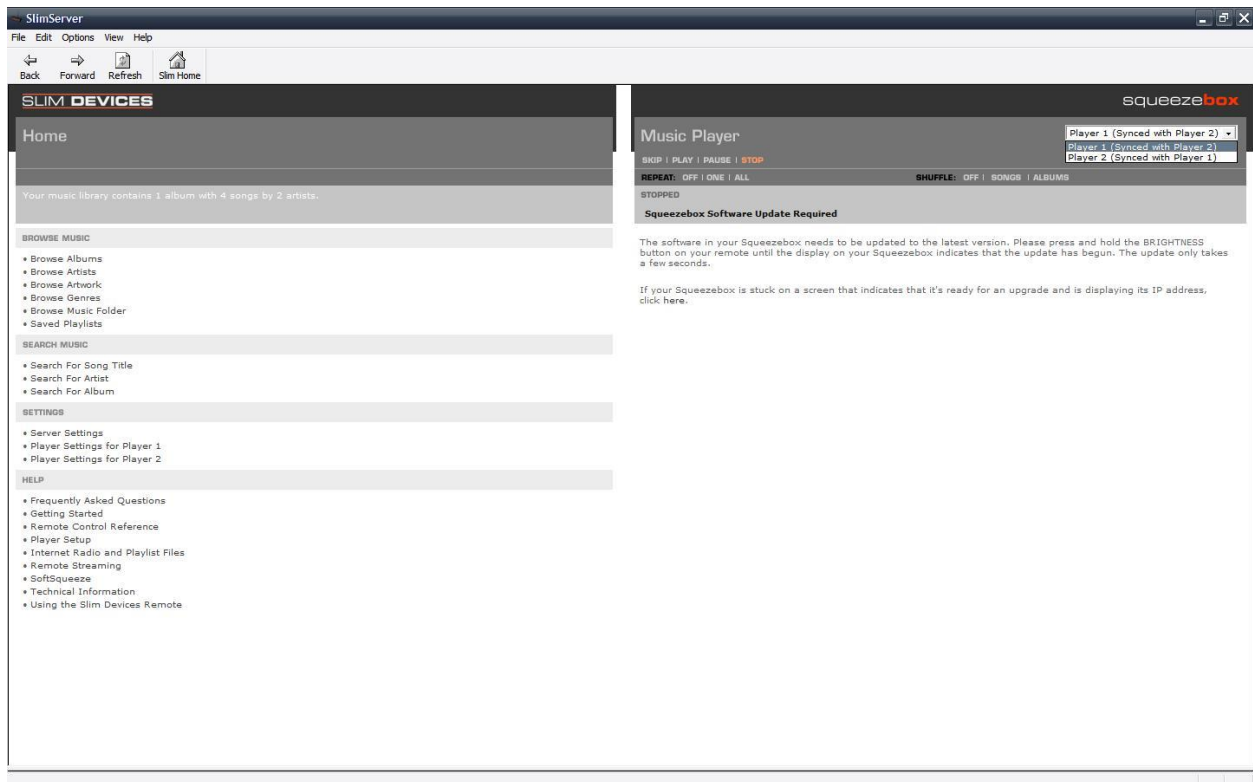
524. As shown below, the SlimServer allows a user to group together different Squeezebox and SoftSqueeze players so that synchronous playback is performed.



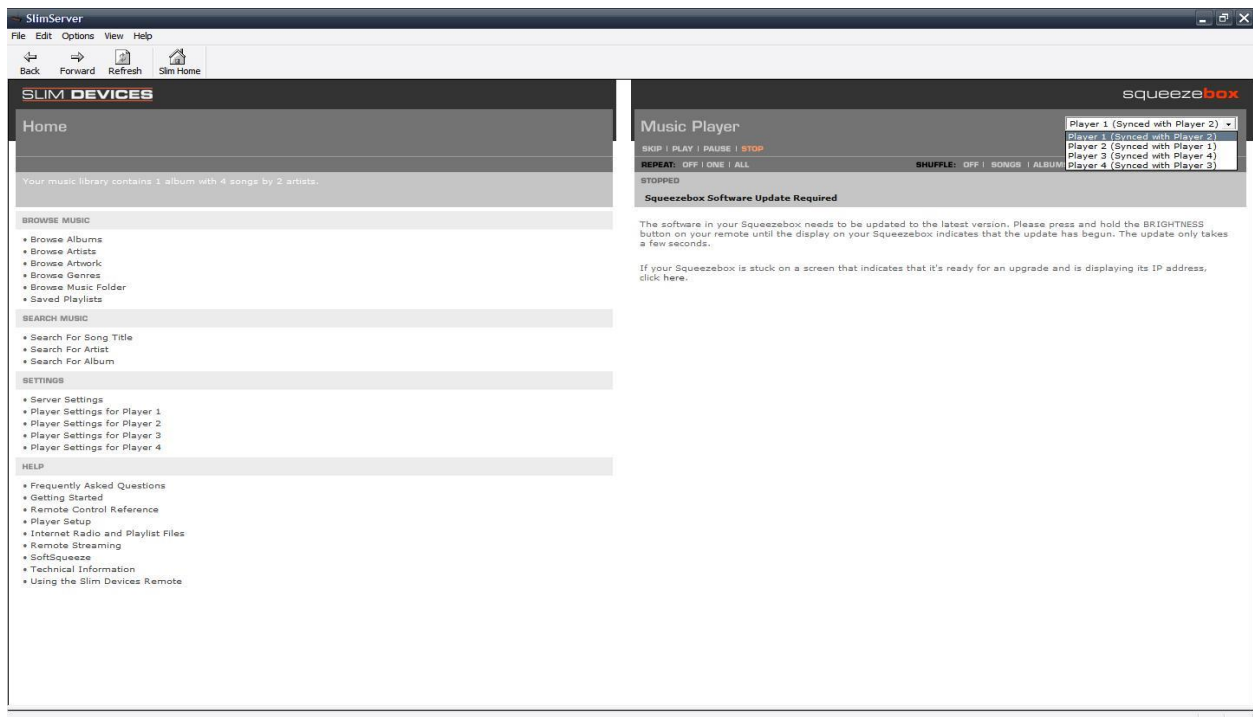
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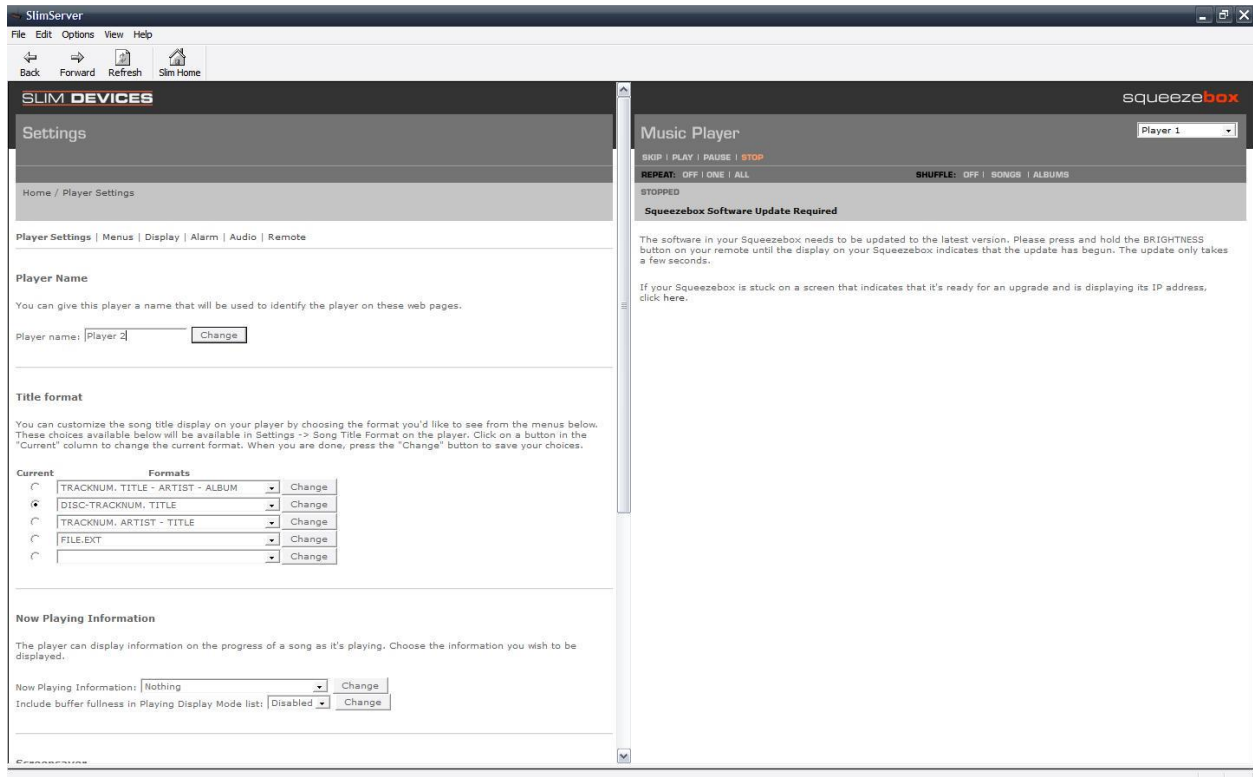


525. This version of the SlimServer allows the user to group Squeezeboxes, such as grouping Player 1 with Player 2 and Player 3 with Player 4.



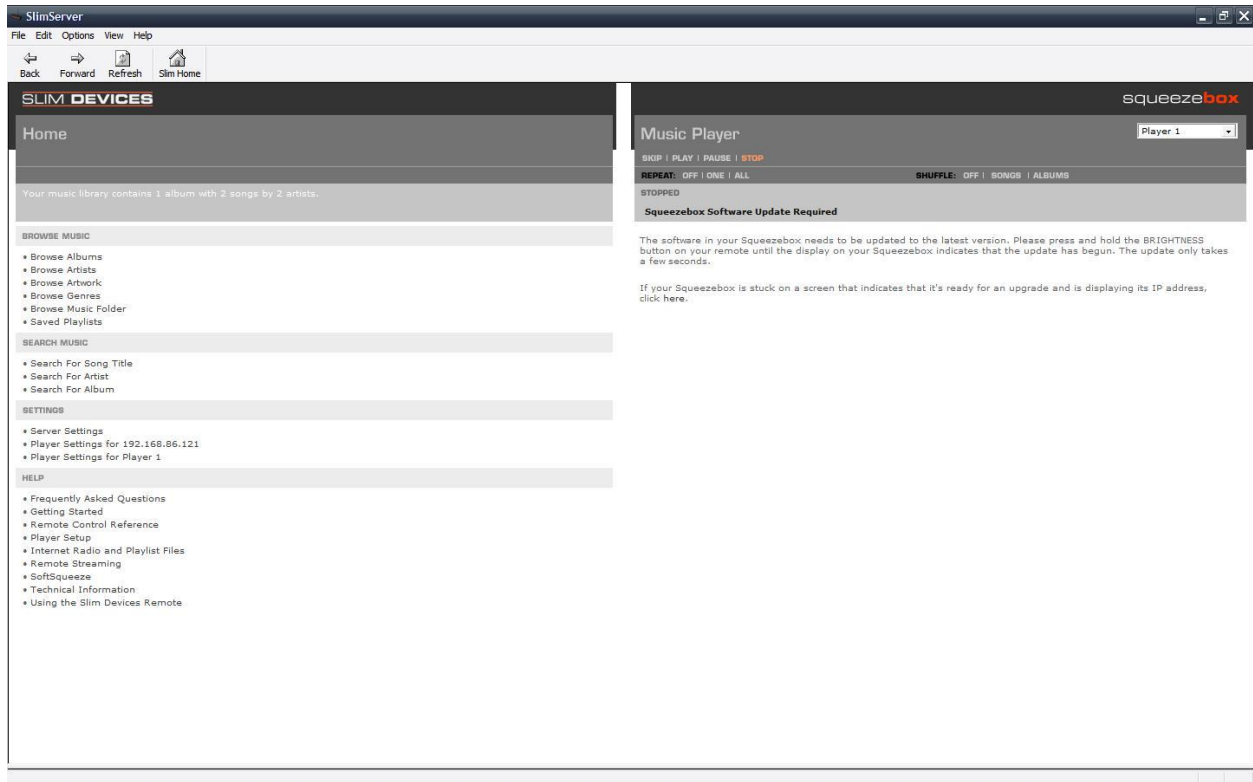
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526. The user of SlimServer may change the name and identifiers of the Squeezebox devices, which in turn changes the name of the grouped Squeezebox devices. The Squeezebox devices may be played to individually or as a group.<sup>11</sup>



<sup>11</sup> At times I refer to Squeezebox or SoftSqueeze devices, but as explained above, these are generally interchangeable as they show the same functionality. SoftSqueeze runs on a computer whereas Squeezebox is a physical device with the same features and functionality. I do not intend reference to one to indicate exclusion of the other.

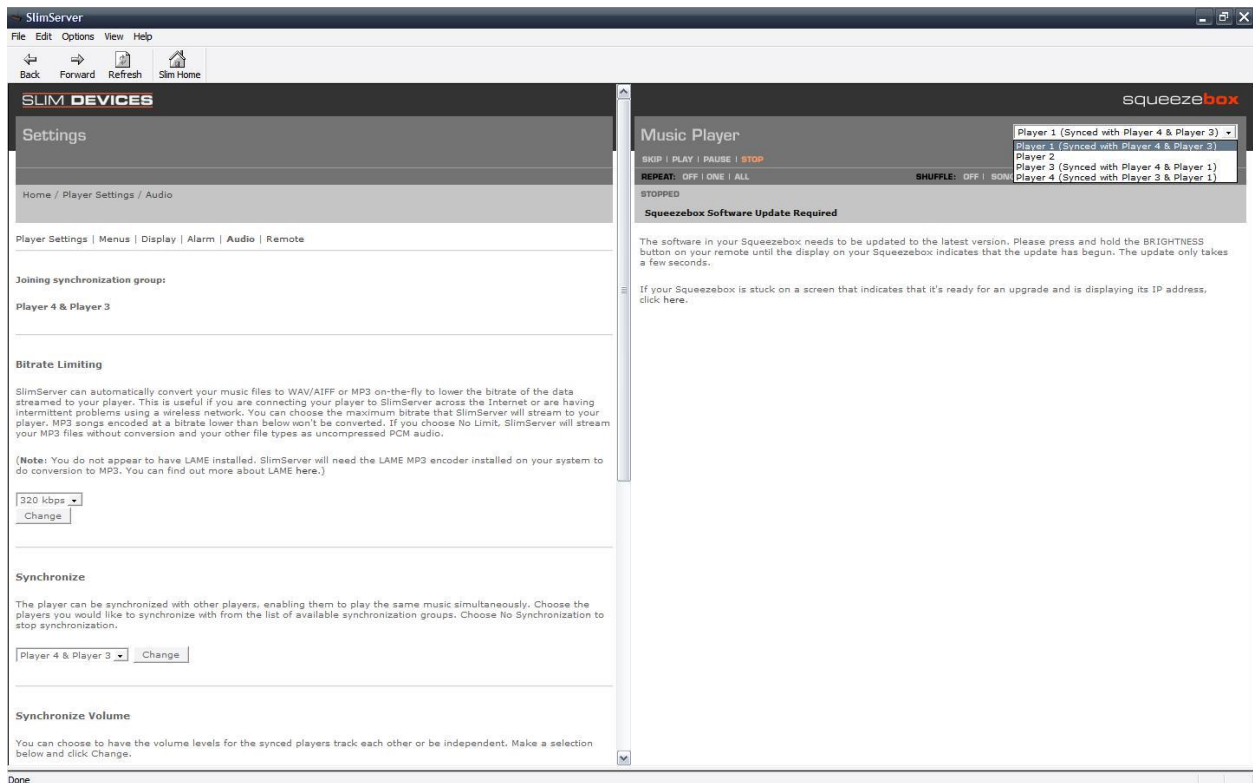
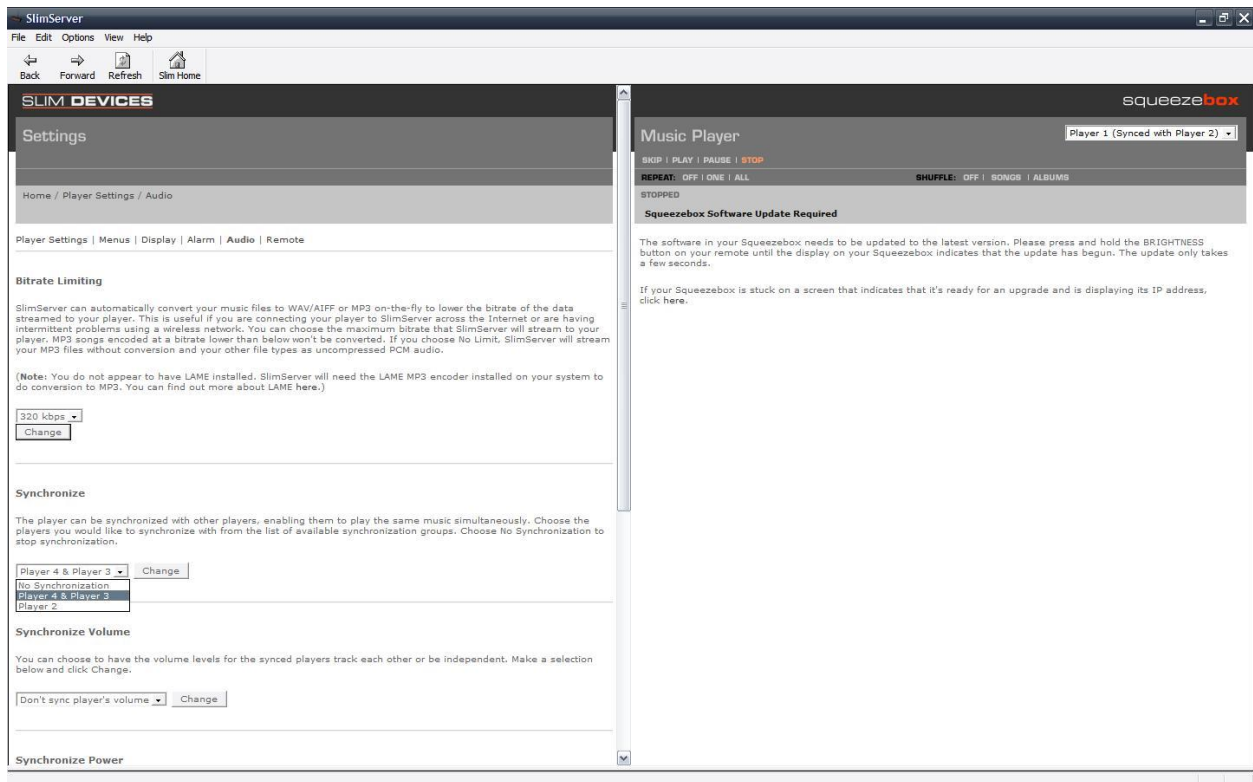
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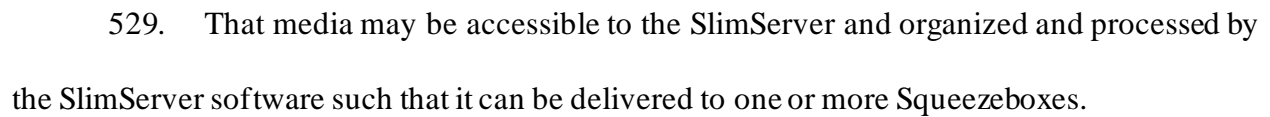
527. SlimServer allows a user to change the synchronization groups after they have been created and stored.



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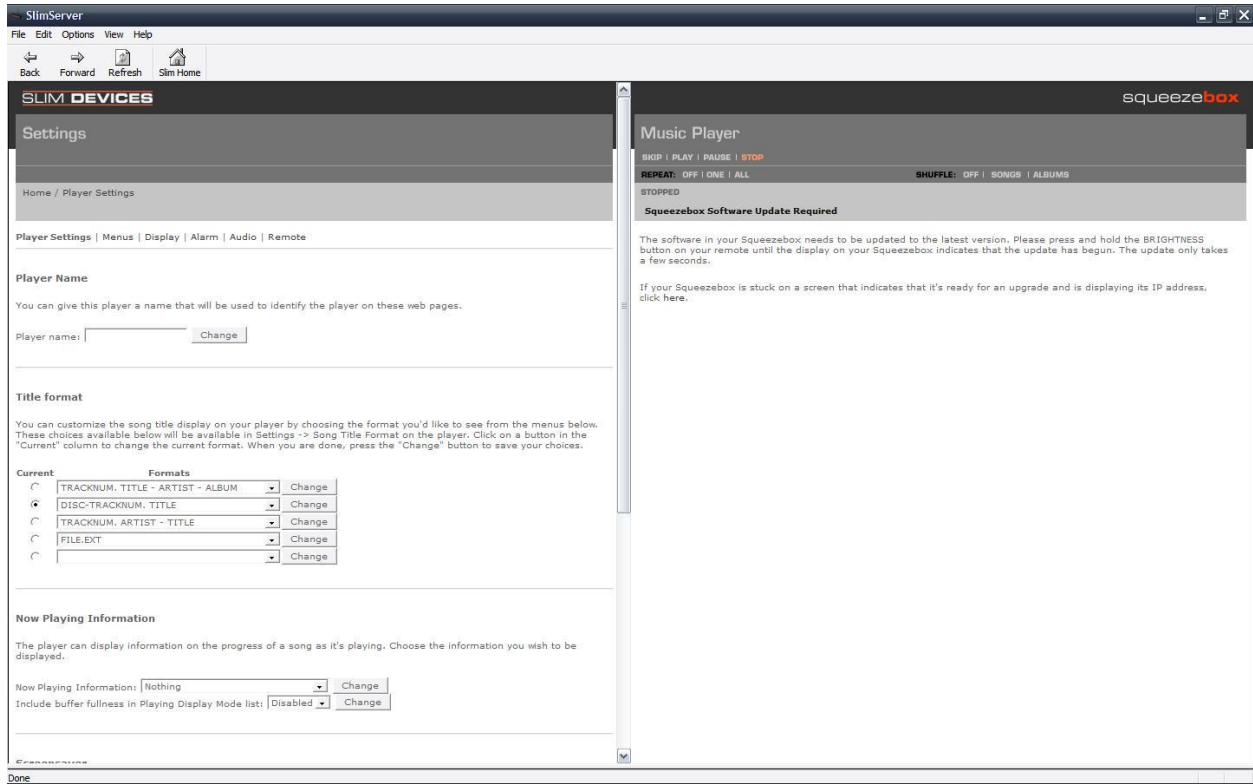


528. SlimServer also allows a Squeezebox to play media without being in a synchronization group, which corresponds to the claimed standalone mode.

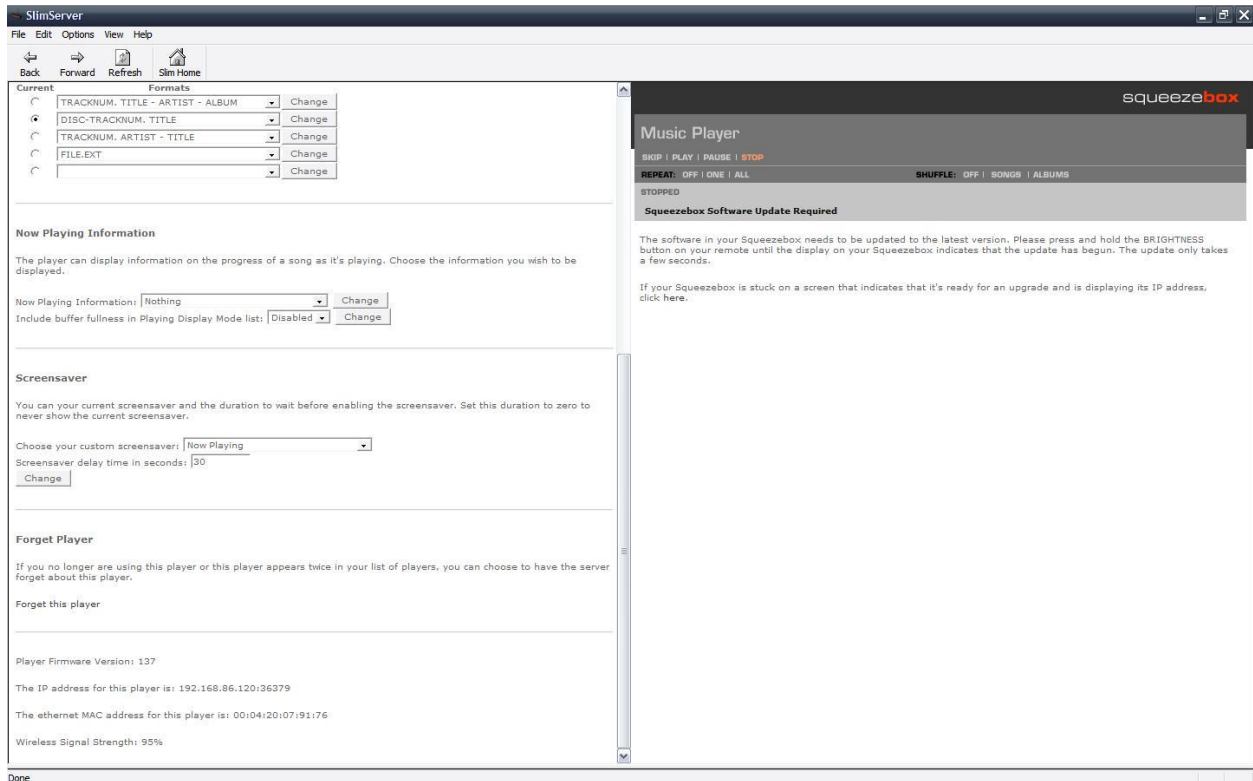
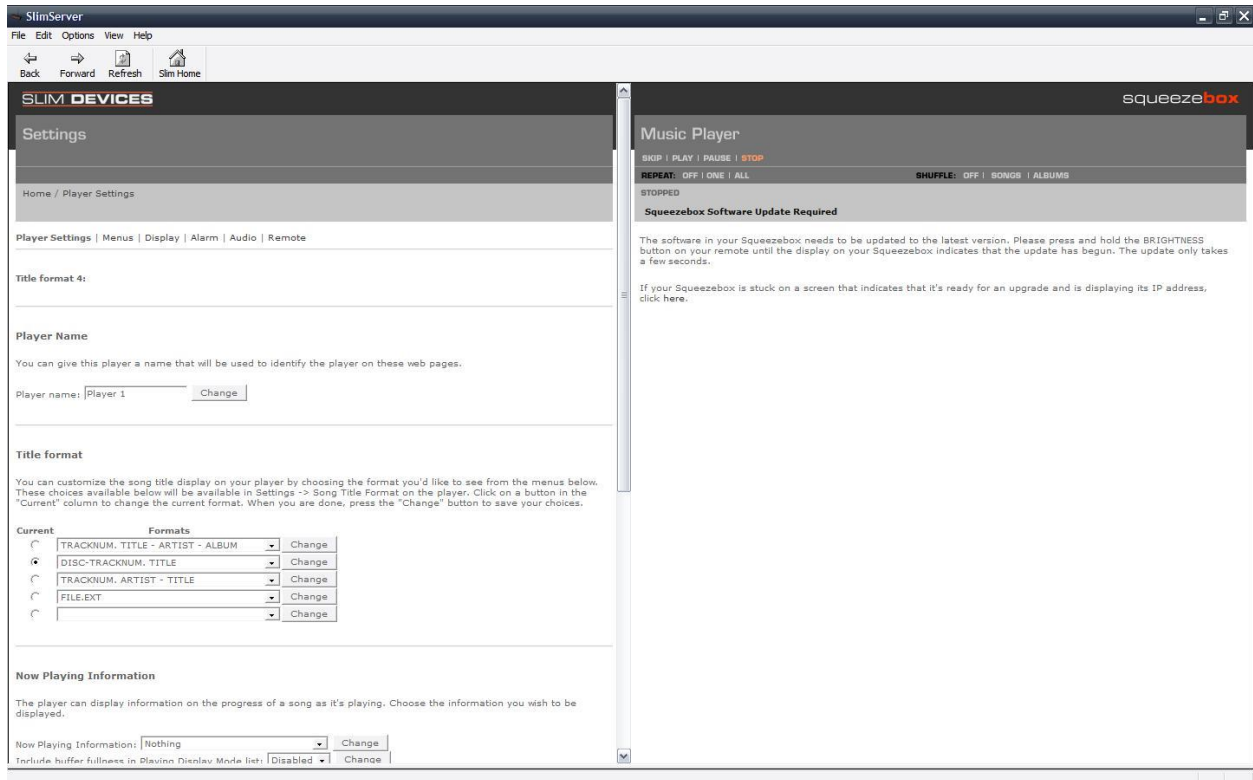


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530. SlimServer also allows a user to change the format in which that media appears on the Squeezebox.

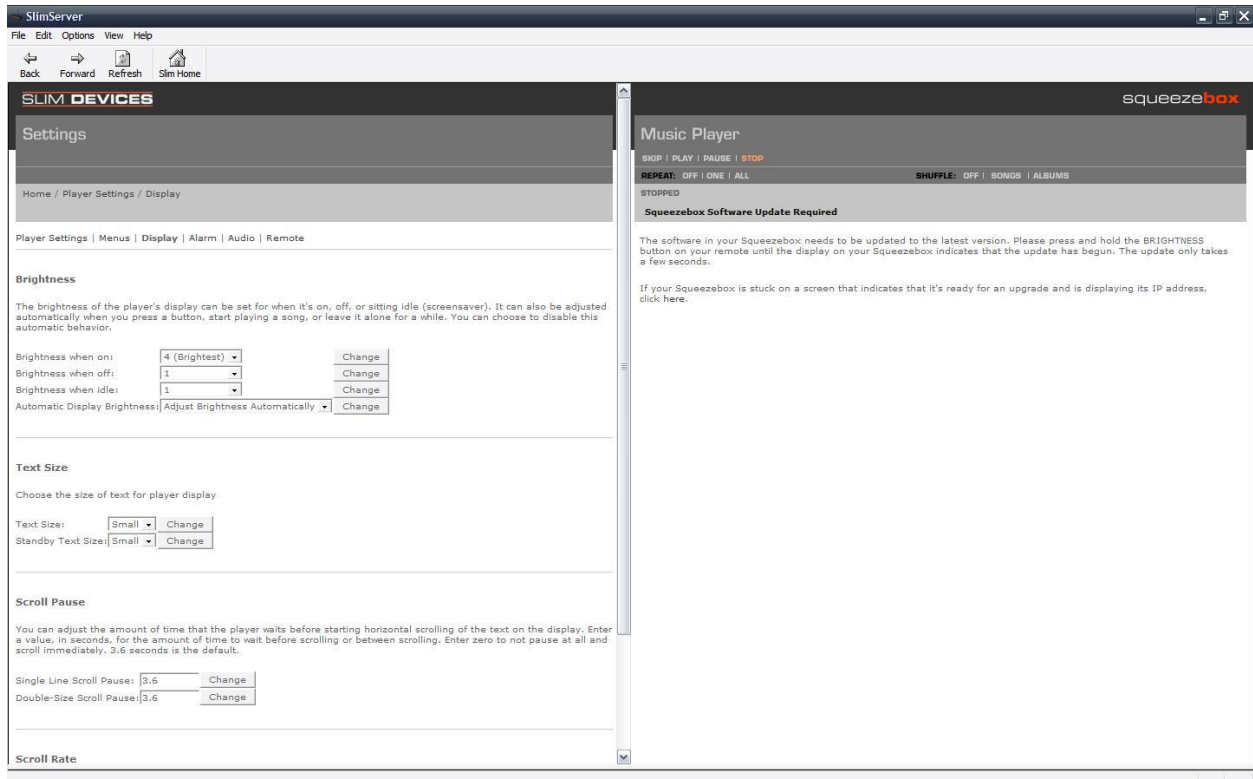
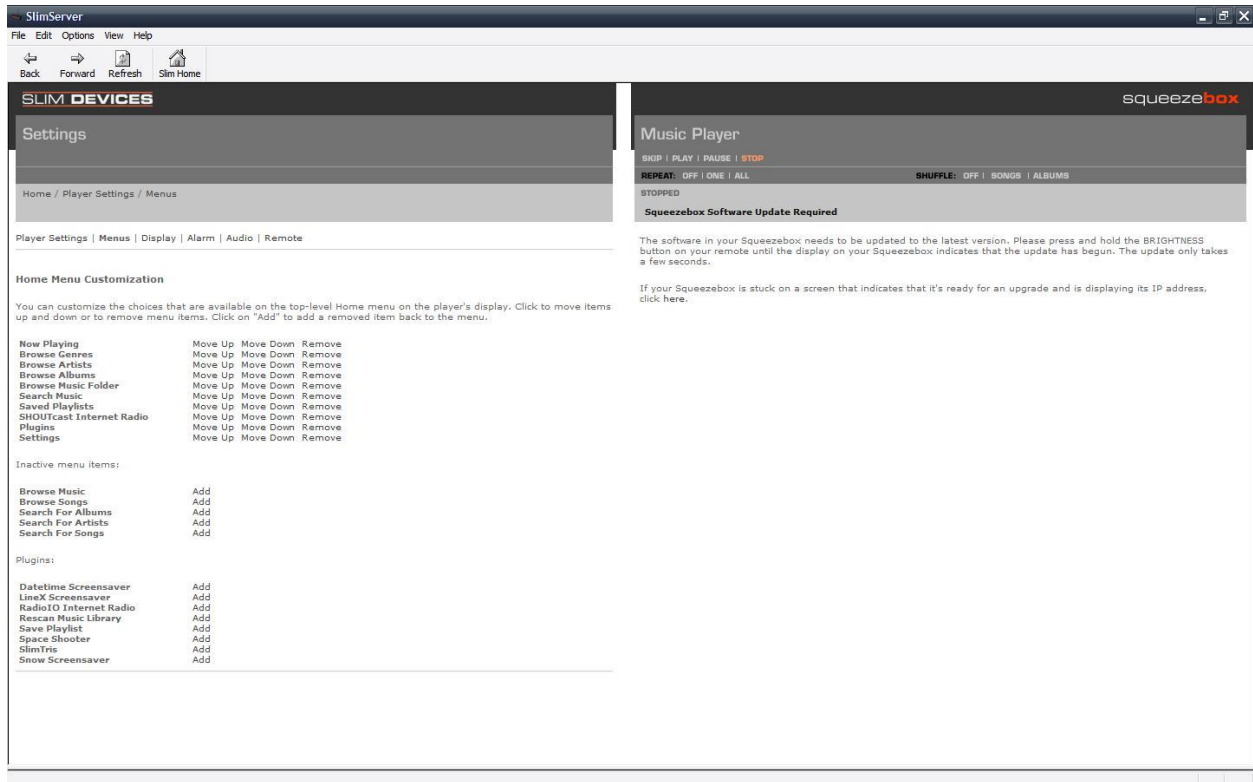


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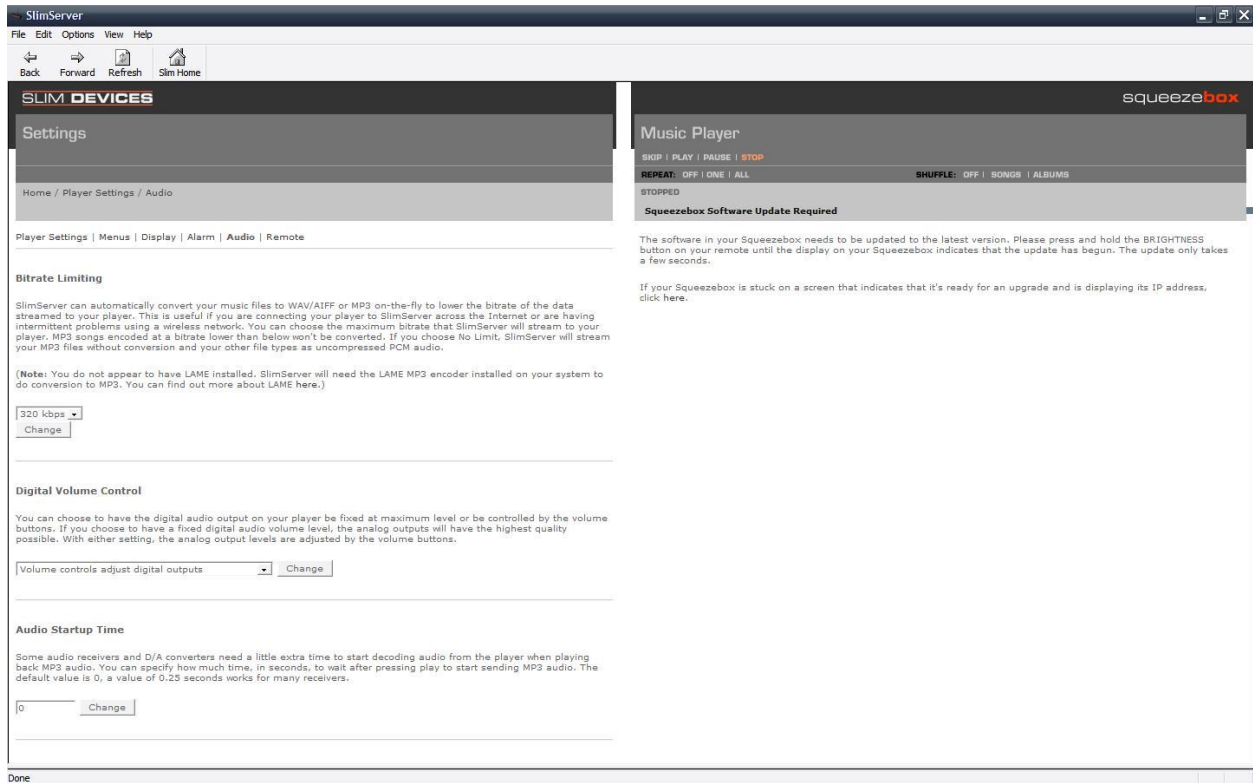
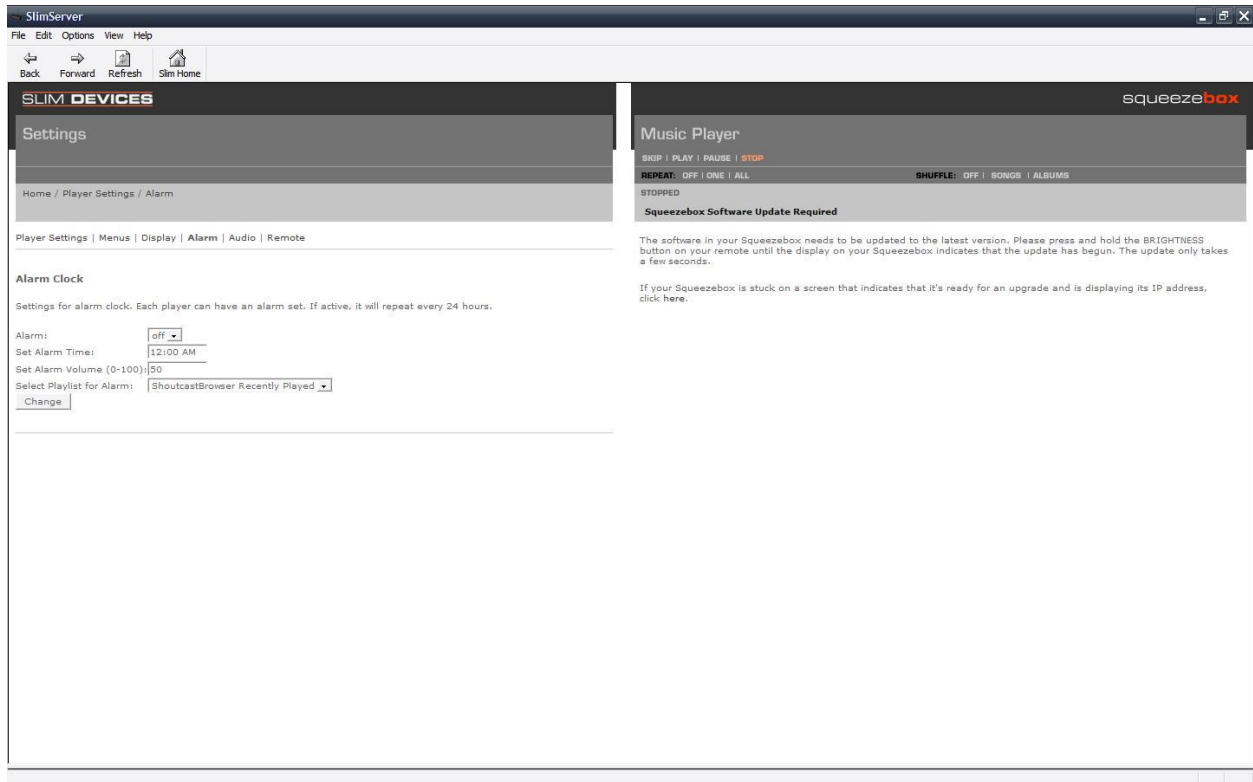


531. Menus and options on Squeezebox are customizable in the SlimServer software, and these configurations are stored in the Squeezebox devices.

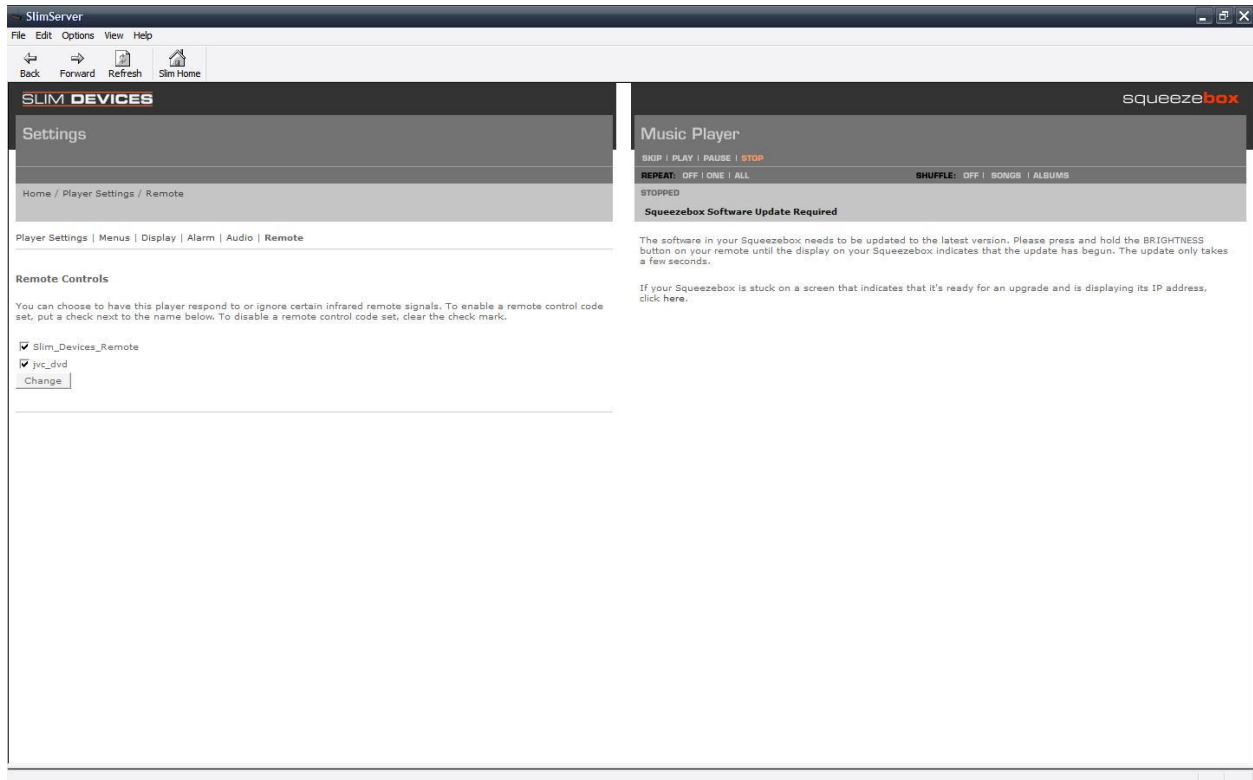
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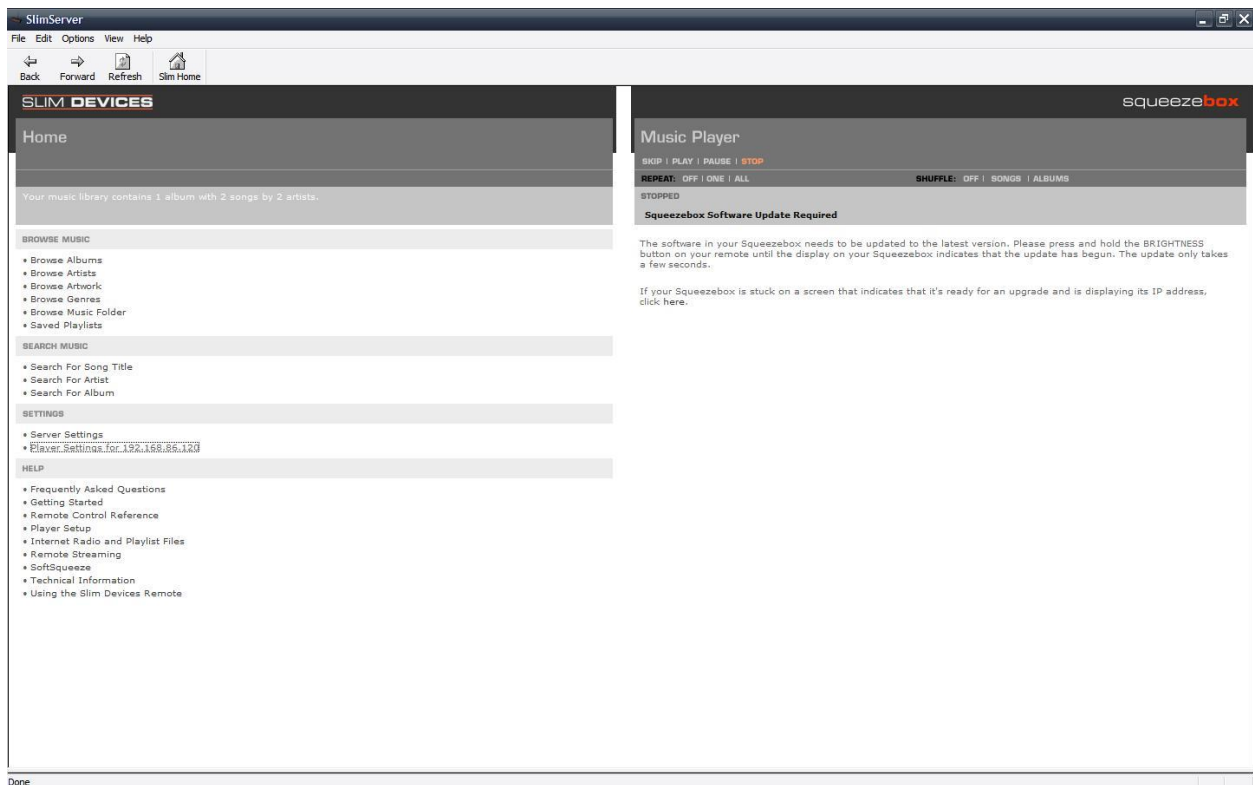
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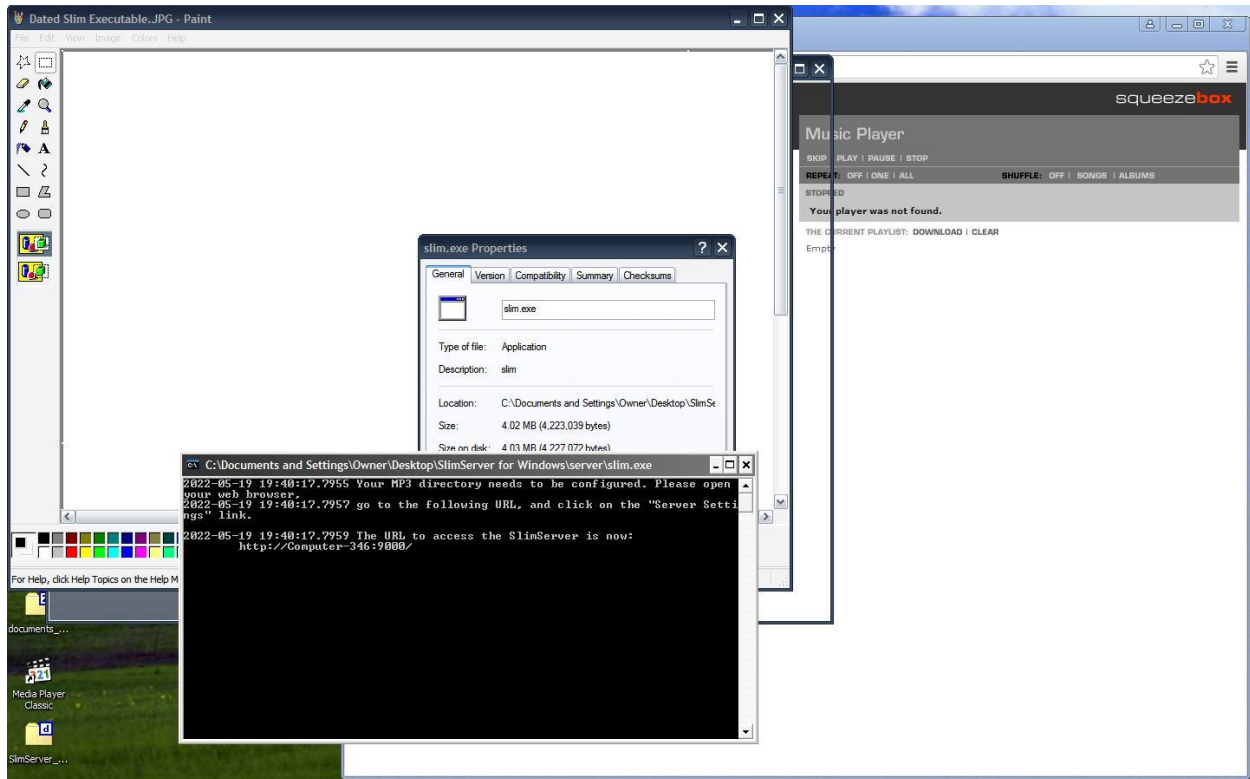
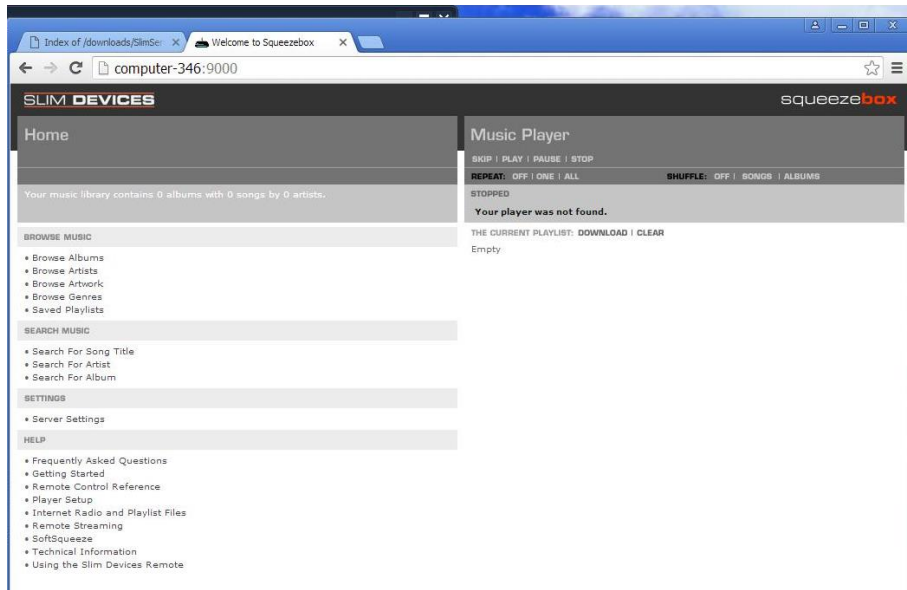


532. The user may name the Squeezebox something other than its IP address.

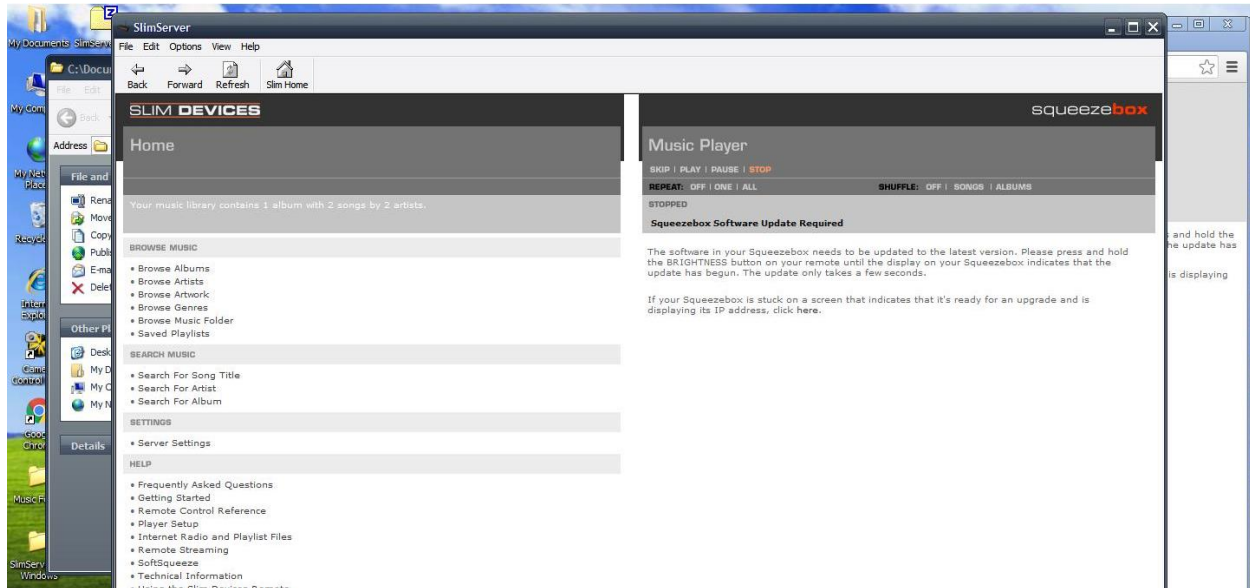
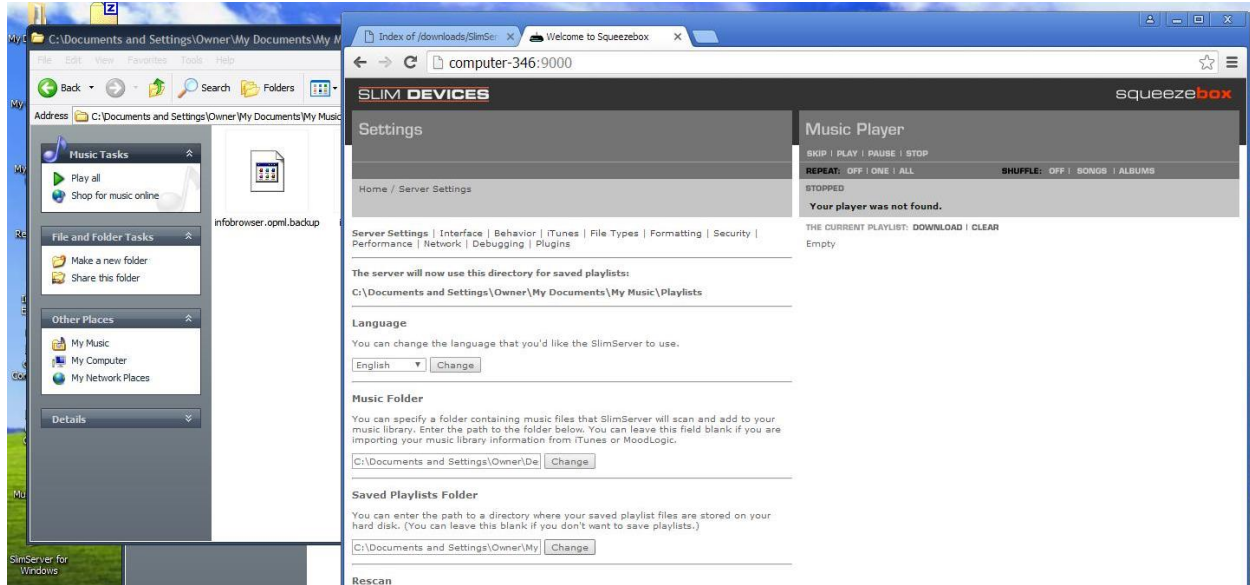




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533. As discussed above, SlimServer supports synchronizing multiple Squeezebox players so that they play the same audio.

#### How do I synchronize two Squeezeboxes so they play the same audio?

Navigate into the Player Settings area with the remote control. Choose Synchronize, then select the other player you want to synchronize with and press the RIGHT button. Both will play the same thing and you can control their synchronized playback from either remote. Go back to the same place and press RIGHT again to unsync.

You can also set up synchroniziation from the Player Settings page in the web interface.

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[http://<SLIMSERVER\\_ADDR>:9000/html/docs/faq.html?player=#setup-sync](http://<SLIMSERVER_ADDR>:9000/html/docs/faq.html?player=#setup-sync) → Home / Frequently Asked Questions → HTML/EN/faqquestions.html.

534. The source code confirms that Squeezebox discloses this claim limitation. The SlimServer server represents sync groups internally using the 'master', 'slaves', and 'syncgroupid' properties for a client (player). The properties are maintained as indexed array elements and accessed using accessor methods—master(), slaves(), and syncgroupid(). A sync group has one group member designated as master, with the remaining group members designated as slaves. For a master client, the 'slaves' property represents an array of slaves which are synced to it. A player is a master if its list of slaves is not empty. For a slave player, the 'master' property points to the master client. A player is a slave if its master property is defined. All members of a group share the same syncgroupid. A client is considered to be synced if it either has slaves or has a master. An unsynced client does not have either a master or slaves.

**Slim/Player/Client.pm (v5.3.1)**

```
=item
master() - type: client
    if we're synchronized, 'master' points to master client
=item
slaves() - type: clients
    if we're a master, this is an array of slaves which are synced to us
=item
syncgroupid() - type: uniqueid
    unique identifier for this sync group
```

Slim::Player::Client::master() comment, Slim/Player/Client.pm (v5.3.1), 297–301  
 Slim::Player::Client::slaves() comment, Slim/Player/Client.pm (v5.3.1), 303–307  
 Slim::Player::Client::syncgroupid() comment, Slim/Player/Client.pm (v5.3.1), 309–313  
 Slim::Player::Client::master(), Slim/Player/Client.pm (v5.3.1), 1195–1198  
 Slim::Player::Client::slaves(), Slim/Player/Client.pm (v5.3.1), 1199–1204  
 Slim::Player::Client::syncgroupid(), Slim/Player/Client.pm (v5.3.1), 1205–1208  
 Slim::Player::Sync::isMaster(), Slim/Player/Sync.pm (v5.3.1), 351–358  
 Slim::Player::Sync::master(), Slim/Player/Sync.pm (v5.3.1), 360–366

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Slim::Player::Sync::slaves(), Slim/Player/Sync.pm (v5.3.1), 368–373  
 Slim::Player::Sync::isSlave(), Slim/Player/Sync.pm (v5.3.1), 376–381  
 Slim::Player::Sync::isSynced(), Slim/Player/Sync.pm (v5.3.1), 388–391

535. When a player (slave) is synced with a master, that player shares the master's playlist.

#### **Slim/Player/Client.pm (v5.3.1)**

```
=item
playlist() - type: array
    playlist of songs (when synced, use the master's)
```

#### **Slim/Player/Playlist.pm**

```
sub playList {
    my ($client) = shift;

    $client = Slim::Player::Sync::masterOrSelf($client);

    return $client->playlist;
}
```

Slim::Player::Client::playlist() comment, Slim/Player/Client.pm (v5.3.1), 207–211  
 Slim::Player::Client::playlist(), Slim/Player/Client.pm (v5.3.1), 1136–1141  
 Slim::Player::Playlist::playlist(), Slim/Player/Playlist.pm (v5.3.1), 54–60

536. The SlimServer persists the membership of a sync group by storing the definition of the syncgroupid property for each group member into the SlimServer's preferences file. When a first player is synced with a second player, the first player is assigned the same syncgroupid as the second player's master. If the master does not already have a syncgroupid, a new one is generated first.

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Slim/Player/Sync.pm (v5.3.1)

```
sub saveSyncPrefs {  
  
    my $client = shift;  
    my $temp = shift;  
    my $clientID = $client->id();  
    if (isSynced($client)) {  
  
        if (!defined($client->master->syncgroupid)) {  
            $client->master->syncgroupid(int(rand 999999999));  
        }  
  
        my $masterID = $client->master->syncgroupid;  
        # Save Status to Prefs file  
        $::d_sync && msg("Saving $clientID as a slave to $masterID\n");  
        Slim::Utils::Prefs::clientSet($client, 'syncgroupid', $masterID);  
        Slim::Utils::Prefs::clientSet($client->master, 'syncgroupid', $masterID);  
  
    }  
    if ($temp) {  
        $::d_sync && msg("Idling Sync for $clientID\n");  
    } else {  
        $client->syncgroupid(undef);  
        Slim::Utils::Prefs::clientDelete($client, 'syncgroupid');  
        $::d_sync && msg("Clearing Sync master for $clientID\n");  
    }  
}
```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 169–194

537. A SlimServer can be instructed to synchronize a first player with a second player in a number of ways, such as by using the web interface, using the CLI, or by using the directional (“arrow”) buttons on the remote to change the synchronization settings. The following discussion focuses on using the remote buttons. The screenshots are for the SoftSqueeze player. The player sends an IR remote code using the SlimProto ‘IR’ command to SlimServer for processing.

"IR " (Note the two spaces to make it up to 4 characters.)  
  
One of these packets is recieved for each IR code recieved by the player.  
  
**Data Length:** Fixed at 10 bytes.  
  
**Format:**  

Time	4 bytes	Time since player startup in ticks (@1Khz)
Format	1 byte	Code Format (ignored by the server for now - Code represents type of IR code - NEC, JVC or Sony)
NoBits	1 byte	Length of IR Code (ignored by the server for now - 16 bits for JVC, 32 bits for NEC?)
IRCode	4 bytes	the IR Code itself (upto 32 bits)

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[http://<SLIMSERVER\\_ADDR>:9000/html/docs/slimproto.html](http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html)  
HTML/EN/html/docs/slimproto.html

538. SlimServer receives IR remote codes and enqueues them for processing.

Slim::Networking::Slimproto::process\_slimproto\_frame(),  
Slim/Networking/Slimproto.pm, at 247–486 at 357–371

539. The enqueued IR remote codes are processed as a ‘button’ command. Button actions are looked up in the function map for the current mode.

Slim::Hardware::IR::idle(), Slim/Hardware/IR.pm, 39–43 at 41  
Slim::Control::Command::execute(), Slim/Control/Command.pm, 24–713 at 686  
Slim::Hardware::IR::processIR(), Slim/Hardware/IR.pm, 334–393 at 388  
Slim::Hardware::IR::processCode(), Slim/Hardware/IR.pm, 552–571 at 569  
Slim::Control::Command::execute(), Slim/Control/Command.pm, 24–713 at 683  
Slim::Hardware::IR::executeButton(), Slim/Hardware/IR.pm, 510–550

540. In particular, the IR buttons allow navigation through the Settings to a ‘Synchronize’ menu to allow an unsynced player to be synchronized with a synchronization group. For example, the directional keys can be used to navigate to the ‘Synchronize’ menu.



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541. The up and down buttons allow selection of synchronization groups. The right button causes the current player to sync with the selected synchronization group. In this example, pressing the right button causes the server to sync player1 with player2 and player3. In the Synchronize mode, the right button causes the client to be synchronized with the selected synchronization group if not already synchronized.



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**Slim/Buttons/Synchronize.pm (v5.3.1)**

```

'right' => sub {
    my $client = shift;

    my $selectedClient = $client->syncSelections($client->syncSelection);

    my $oldlines = Slim::Display::Display::curLines($client);

    if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || ($client eq $selectedClient))
    {
        Slim::Player::Sync::unsync($client);
    } else {
        Slim::Player::Sync::sync($client, $selectedClient);
    }
    $client->pushLeft("\@oldlines, [Slim::Display::Display::curLines($client)]);
},

```

\$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm, 34–47 at 44

Slim::Player::Sync::sync(), Slim/Player/Sync.pm, 132–167

542. After the synchronization, SlimServer stores the updated syncgroupid settings to the preferences file.

**Slim/Player/Sync.pm (v5.3.1)**

```

sub saveSyncPrefs {

    my $client = shift;
    my $temp = shift;
    my $clientID = $client->id();
    if (isSynced($client)) {

        if (!defined($client->master->syncgroupid)) {
            $client->master->syncgroupid(int(rand 999999999));
        }

        my $masterID = $client->master->syncgroupid;
        # Save Status to Prefs file
        $::d_sync && msg("Saving $clientID as a slave to $masterID\n");
        Slim::Utils::Prefs::clientSet($client, 'syncgroupid', $masterID);
        Slim::Utils::Prefs::clientSet($client->master, 'syncgroupid', $masterID);

    }
    if ($temp) {
        $::d_sync && msg("Idling Sync for $clientID\n");
    } else {
        $client->syncgroupid(undef);
        Slim::Utils::Prefs::clientDelete($client, 'syncgroupid');
        $::d_sync && msg("Clearing Sync master for $clientID\n");
    }
}

```

Slim::Player::Sync::sync(), Slim/Player/Sync.pm, 132–167 at 163

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm, 169–194 at 174–184

543. In this example, the preferences file identifies player1, player2, and player3 with

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the same syncgroupid (450486363).

#### slimserver.conf

```
0f:59:51:64:dc:d7-playername = player2
...
0f:59:51:64:dc:d7-syncgroupid = 450486363
...
51:93:a5:ad:53:20-playername = player3
...
51:93:a5:ad:53:20-syncgroupid = 450486363
...
bc:39:f3:c4:1e:29-playername = player1
...
bc:39:f3:c4:1e:29-syncgroupid = 450486363
```

544. After performing the synchronization action and saving preferences, the server sends updated screen lines to the server indicating that the right-button action has been changed to unsync with player2 and player3. The updated message encoded into an update that pushes the old pre-sync message lines (@oldlines) off the screen to the left, replaced with new screen lines.

#### Slim/Buttons/Synchronize.pm (v5.3.1)

```
'right' => sub {
    my $client = shift;

    my $selectedClient = $client->syncSelections($client->syncSelection);

    my @oldlines = Slim::Display::Display::curLines($client);

    if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || ($client eq $selectedClient))
    {
        Slim::Player::Sync::unsync($client);
    } else {
        Slim::Player::Sync::sync($client, $selectedClient);
    }
    $client->pushLeft("\@oldlines, [Slim::Display::Display::curLines($client)]);
},
```

545. Because the player is now synced, the updated screen lines change from the localized SYNC\_WITH message to the localized UNSYNC\_WITH message.

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**Slim/Buttons/Synchronize.pm (v5.3.1)**

```

sub lines {
    my $client=shift;
    my $line1;
    my $line2;
    my $symbol = undef;

    loadList($client);

    if (scalar @{$client->syncSelections} < 1) {
        warn "Can't sync without somebody to sync with!";
        Slim::Buttons::Common::popMode($client);
    } else {
        # get the currently selected client
        my $selectedClient = $client->syncSelections($client->syncSelection);

        if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || $selectedClient eq
$client) {
            $line1 = Slim::Utils::Strings::string('UNSYNC_WITH');
        } else {
            $line1 = Slim::Utils::Strings::string('SYNC_WITH');
        }
        $line2 = buddies($client, $selectedClient);
    }
    return ($line1, $line2, undef, Slim::Display::Display::symbol('rightarrow'));
}

```

\$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm,  
34–47 at 46

Slim::Display::Display::curLines(), Slim/Display/Display.pm, 104–120 at 115

Slim::Buttons::Synchronize::lines(), Slim/Buttons/Synchronize.pm, 67–90 at 79–  
87

UNSYNC\_WITH localization, strings.txt, 6531–6540

546. The old and new screen lines are rendered into start and end graphic (bit), which are concatenated into one large screen. SlimServer then issues a series of Slimproto frame buffer messages (‘grfd’ messages for SqueezeboxG devices) to the player over TCP, starting with a screen that shows only the start screen lines and then shifting left in successive messages until the final message shows only the end screen lines.

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\$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm, 34–47 at 46

Slim::Player::SqueezeboxG::pushLeft(), Slim/Player/SqueezeboxG.pm, 401–414 at 413

Slim::Player::SqueezeboxG::pushUpdate(), Slim/Player/SqueezeboxG.pm, 447–464 at 459

Slim::Player::SqueezeboxG::drawFrameBuf(), Slim/Player/SqueezeboxG.pm, 368–382 at 380

Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm, 514–533

547. The ‘grfd’ message is not documented in “The SlimProto TCP Protocol” page that is included with the v5.3.1 distribution, but it is mentioned in the “SlimProtoTCP protocol” page on the Squeezebox wiki as being used to draw graphics for SqueezeboxG. *E.g.*, [https://wiki.slimdevices.com/index.php/SlimProtoTCPProtocol.html#Command\\_.22grfd.22](https://wiki.slimdevices.com/index.php/SlimProtoTCPProtocol.html#Command_.22grfd.22).

548. As discussed above, for example, a network device may comprise a SlimServer connected to Squeezeboxes or SoftSqueezes over a data network (Ethernet or Wi-Fi) and it may provide an indication to the Squeezebox or SoftSqueeze players that it has been added to a synchronization group comprising one or more other Squeezebox or SoftSqueeze players, including a graphical indication displayed on those players. When media is played to the synchronization group, the players—depending on their configuration as discussed further below—within that group will respond and play back music synchronously.

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549. As shown below, a SlimDevice allowed a user to carry out an action to add a Squeezebox player to a group of Squeezeboxes so that synchronous playback is performed. In particular, the IR buttons allow navigation through the Settings to a “Synchronize” menu to allow an unsynced player to be synchronized with a synchronization group. For example, the directional keys can be used to navigate to the “Synchronize” menu.



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550. The up and down buttons allow selection of synchronization groups. The right button causes the current player to sync with the selected synchronization group. In this example, pressing the right button causes the server to sync player1 with player2 and player3. In the Synchronize mode, the right button causes the client to be synchronized with the selected synchronization group if not already synchronized. The source code below indicates that a message is sent to players 2 and 3.

#### Slim/Buttons/Synchronize.pm (v5.3.1)

```
'right' => sub {
    my $client = shift;

    my $selectedClient = $client->syncSelections($client->syncSelection);

    my @oldlines = Slim::Display::Display::curLines($client);

    if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || ($client eq $selectedClient))
    {
        Slim::Player::Sync::unsync($client);
    } else {
        Slim::Player::Sync::sync($client, $selectedClient);
    }
    $client->pushLeft(\@oldlines, [Slim::Display::Display::curLines($client)]);
},
```

\$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm, 34–47 at 44

Slim::Player::Sync::sync(), Slim/Player/Sync.pm, 132–167

551. After the synchronization, the SlimServer stores the updated syncgroupid settings

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to the preferences file.

**Slim/Player/Sync.pm (v5.3.1)**

```
sub saveSyncPrefs {

    my $client = shift;
    my $temp = shift;
    my $clientID = $client->id();
    if (isSynced($client)) {

        if (!defined($client->master->syncgroupid)) {
            $client->master->syncgroupid(int(rand 999999999));
        }

        my $masterID = $client->master->syncgroupid;
        # Save Status to Prefs file
        $::d_sync && msg("Saving $clientID as a slave to $masterID\n");
        Slim::Utils::Prefs::clientSet($client, 'syncgroupid', $masterID);
        Slim::Utils::Prefs::clientSet($client->master, 'syncgroupid', $masterID);

    }
    if ($temp) {
        $::d_sync && msg("Idling Sync for $clientID\n");
    } else {
        $client->syncgroupid(undef);
        Slim::Utils::Prefs::clientDelete($client, 'syncgroupid');
        $::d_sync && msg("Clearing Sync master for $clientID\n");
    }
}
```

Slim::Player::Sync::sync(), Slim/Player/Sync.pm, 132–167 at 163

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm, 169–194 at 174–184

552. In this example, the preferences file identifies player1, player2, and player3 with the same syncgroupid (450486363).

**slimserver.conf**

```
0f:59:51:64:dc:d7-playername = player2
...
0f:59:51:64:dc:d7-syncgroupid = 450486363
...
51:93:a5:ad:53:20-playername = player3
...
51:93:a5:ad:53:20-syncgroupid = 450486363
...
bc:39:f3:c4:1e:29-playername = player1
...
bc:39:f3:c4:1e:29-syncgroupid = 450486363
```

553. As discussed above, a network device may comprise a SlimServer connected to Squeezeboxes or SoftSqueezes over a data network (Ethernet or Wi-Fi) and it may provide an indication to the Squeezebox or SoftSqueeze players that it has been added to a synchronization group comprising one or more other Squeezebox or SoftSqueeze players, including a graphical



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indication displayed on those players. When media is played to the synchronization group, the players—depending on their configuration as discussed further below—within that group will respond and play back music synchronously. I note that a powered-off player is temporarily unsynced but still defined to be part of a persistent sync group.

554. The messages passed to the Squeezebox or SoftSqueeze players after user selection match the Court’s description of the claimed “indication.” Those messages need not identify other speakers within the claimed zone scene, and it can be the user action that indicates a desire to “add” the speaker to the zone scene and thus the subsequent messages transmitted to the player indicate that the speaker “has been added” to the zone scene. As such, in view of the Court’s Order, Logitech’s prior art system disclosed the “indication” limitations recited in the asserted claim.

555. Additionally, as I discussed above, the Court’s Order with respect to Limitation 1.6 further supports my opinion that Logitech’s prior art system also discloses the “configured to coordinate” element of Limitation 1.10. This is because the “coordinat[ion]” element can be met by a similar user action including, for example, a user adding a player to a synchrony group via a UI action, followed by a message to the zone player. As I discussed above, UI buttons on the Squeezebox device itself allow a user to initiate synchronization of the device with a synchronization group.

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556. As shown below, following the UI selection, there is coordination in terms of (1) using the leader (“master”) Squeezebox’s playlist and (2) pushing the playlist content to be played back to the other players, for example in “chunks.” The source code reproduced below is written from the point of view of the “master” Squeezebox, and performs actions to synchronize this “master” Squeezebox with the other Squeezebox players in the sync group. While I understand the below screenshot to be of server-side code, it nonetheless reflects a leader (“master”) and follower (“slave”) structure in which the leader Squeezebox coordinates with multiple follower Squeezeboxes (“let[ting] everybody I’m sync’ed with”) to playback each “chunk in the queue,” in synchrony. Compare with SONOS-SVG2-00227433 and SONOS-SVG2-00227434 (discussing master/slave speaker coordination implementation in the Sonos System). The master’s playlist and shuffle list (indices into playlist) is used for all clients (players) in the sync group. The client’s (player’s) master is determined by the masterOrSelf() function, which returns the master when the client is a synced slave and the client itself otherwise (*i.e.*, synced master or unsynced client). See, *e.g.*, (v5.3.1): playlist() and shufflelist() comments, Slim/Player/Client.pm (v5.3.1), 207-217; Slim::Player::Playlist::shuffleList(), Slim/Player/Playlist.pm (v5.3.1), 46-52; Slim::Player::Playlist::playList(), Slim/Player/Playlist.pm (v5.3.1), 54-60;

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Slim::Player::Sync::masterOrSelf(), Slim/Player/Sync.pm (v5.3.1), 383–386.

```
=item
playlist() - type: array
    playlist of songs (when synced, use the master's)
=item
shufflelist() - type: array
    array of indices into playlist which may be shuffled (when synced, use the master's)
```

Slim/Player/Client.pm (v5.3.1)

```
sub shuffleList {
    my ($client) = shift;

    $client = Slim::Player::Sync::masterOrSelf($client);

    return $client->shufflelist;
}

sub playList {
    my ($client) = shift;

    $client = Slim::Player::Sync::masterOrSelf($client);

    return $client->playlist;
}
```

Slim/Player/Playlist.pm (v5.3.1)

```
sub masterOrSelf {
    my $client = shift;
    return $client->master || $client;
}
```

Slim/Player/Sync.pm (v5.3.1)

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```
sub shuffle {  
  my $client = shift;  
  my $shuffle = shift;  
  
  $client = Slim::Player::Sync::masterOrSelf($client);  
  
  if (defined($shuffle)) {  
    Slim::Utils::Prefs::clientSet($client, "shuffle", $shuffle);  
  }  
  
  return Slim::Utils::Prefs::clientGet($client, "shuffle");  
}  
  
sub repeat {  
  my $client = shift;  
  my $repeat = shift;  
  
  $client = Slim::Player::Sync::masterOrSelf($client);  
  
  if (defined($repeat)) {  
    Slim::Utils::Prefs::clientSet($client, "repeat", $repeat);  
  }  
  
  return Slim::Utils::Prefs::clientGet($client, "repeat");  
}
```

Slim/Player/Playlist.pm (v5.3.1)

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```

sub removeTrack {
  my $client = shift;
  my $tracknum = shift;

  my $playlistIndex = ${shuffleList($client)}[$tracknum];

  my $stopped = 0;
  my $oldmode = Slim::Player::Source::playmode($client);

  if ($tracknum == Slim::Player::Source::currentSongIndex($client)) {
    Slim::Player::Source::playmode($client, "stop");
    $stopped = 1;
  } elsif ($tracknum < Slim::Player::Source::currentSongIndex($client)) {
    Slim::Player::Source::currentSongIndex($client, Slim::Player::Source::currentSongIndex($client)
- 1);
  }

  splice(@{playList($client)}, $playlistIndex, 1);

  my @reshuffled;
  my $counter = 0;
  foreach my $i (@{shuffleList($client)}) {
    if ($i < $playlistIndex) {
      push @reshuffled, $i;
    } elsif ($i > $playlistIndex) {
      push @reshuffled, ($i - 1);
    } else {
    }
  }

  $client = Slim::Player::Sync::masterOrSelf($client);

  @{ $client->shufflelist } = @reshuffled;

  if ($stopped && ($oldmode eq "play")) {
    Slim::Player::Source::jumpTo($client, $tracknum);
  }

  refreshPlaylist($client);
}

```

Slim/Player/Playlist.pm (v5.3.1)

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```

sub removeMultipleTracks {
  my $client = shift;
  my $songlist = shift;

  my %songlistentries;
  if (defined($songlist) && ref($songlist) eq 'ARRAY') {
    foreach my $item (@$songlist) {
      $songlistentries{$item}=1;
    }
  }

  my $stopped = 0;
  my $oldmode = Slim::Player::Source::playmode($client);

  my $curtrack = ${shuffleList($client)}[Slim::Player::Source::currentSongIndex($client)];

  my $i=0;
  my $oldcount=0;
  # going to need to renumber the entries in the shuffled list
  # will need to map the old position numbers to where the track ends
  # up after all the deletes occur
  my %oldToNew;
  while ($i <= ${playList($client)}) {
    #check if this file meets all criteria specified
    my $thistrack=${playList($client)}[$i];
    if (exists($songlistentries{$thistrack})) {
      splice(@{playList($client)}, $i, 1);
      if ($curtrack == $oldcount) {
        Slim::Player::Source::playmode($client, "stop");
        $stopped = 1;
      }
    } else {
      $oldToNew{$oldcount}=$i;
      $i++;
    }
    $oldcount++;
  }

  my @reshuffled;
  my $newtrack;
  my $getnext=0;
  # renumber all of the entries in the shuffle list with their
  # new positions, also get an update for the current track, if the
  # currently playing track was deleted, try to play the next track
  # in the new list
  foreach my $oldnum (@{shuffleList($client)}) {
    if ($oldnum == $curtrack) { $getnext=1; }
    if (exists($oldToNew{$oldnum})) {
      push(@reshuffled,$oldToNew{$oldnum});
      if ($getnext) {
        $newtrack=$#reshuffled;
        $getnext=0;
      }
    }
  }
}

```

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```

}

# if we never found a next, we deleted everything after the current
# track, wrap back to the beginning
if ($getnext) { $newtrack=0; }

$client = Slim::Player::Sync::masterOrSelf($client);

@{$client->shufflelist} = @reshuffled;

if ($stopped && ($oldmode eq "play")) {
    Slim::Player::Source::jumpTo($client,$newtrack);
} else {
    Slim::Player::Source::currentSongIndex($client,$newtrack);
}

refreshPlaylist($client);
}

```

Slim/Player/Playlist.pm (v5.3.1)

```

sub insert_done {
    my ($client, $listsize, $size,$callbackf, $callbackargs)=@_;
    my $i;
    my $playlistIndex = Slim::Player::Source::currentSongIndex($client)+1;
    my @reshuffled;

    if (Slim::Player::Playlist::shuffle($client)) {
        for ($i = 0; $i < $size; $i++) {
            push @reshuffled,$listsize+$i;
        };
        $client = Slim::Player::Sync::masterOrSelf($client);

        splice @{$client->shufflelist},$playlistIndex, 0, @reshuffled;
    } else {
        Slim::Player::Playlist::moveSong($client, $listsize, $playlistIndex,$size);
        Slim::Player::Playlist::reshuffle($client);
    };
    Slim::Player::Playlist::refreshPlaylist($client);
    $callbackf && (&$callbackf (@$callbackargs));
    Slim::Control::Command::executeCallback($client, ['playlist','load_done']);
}

```

Slim/Control/Command.pm (v5.3.1)

557. General song properties (*e.g.*, total bytes, duration, offset, and current playing song) are taken from the master. *See, e.g.*, (v5.3.1) Slim::Player::Client::songtotalbytes(), Slim/Player/Client.pm (v5.3.1), 1164-1167; Slim::Player::Client::songduration(),



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Slim/Player/Client.pm (v5.3.1), 1168-1171; Slim::Player::Client::songoffset(),  
 Slim/Player/Client.pm (v5.3.1), 1172-1175; Slim::Player::Client::currentplayingsong(),  
 Slim/Player/Client.pm (v5.3.1), 1182-1185.

```
sub songtotalbytes {
  my $r = Slim::Player::Sync::masterOrSelf(shift);
  @_ ? ($r->[34] = shift) : $r->[34];
}
sub songduration {
  my $r = Slim::Player::Sync::masterOrSelf(shift);
  @_ ? ($r->[35] = shift) : $r->[35];
}
sub songoffset {
  my $r = Slim::Player::Sync::masterOrSelf(shift);
  @_ ? ($r->[36] = shift) : $r->[36];
}
```

Slim/Player/Client.pm (v5.3.1)

```
sub currentplayingsong {
  my $r = Slim::Player::Sync::masterOrSelf(shift);
  @_ ? ($r->[38] = shift) : $r->[38];
}
```

Slim/Player/Client.pm (v5.3.1)

558. Song-related code (such as code dealing with playback progress, song time, and song index) operates on the master's song. *See, e.g.,* (v5.3.1) Slim::Player::Source::progress(), Slim/Player/Source.pm (v5.3.1), 180-189 at 183; Slim::Player::Source::songTime(), Slim/Player/Source.pm (v5.3.1), 191-238 at 193; Slim::Player::Source::currentSongIndex(), Slim/Player/Source.pm (v5.3.1), 191-238 at 193.

559. Playlist management code (*e.g.,* shuffle, repeat, remove, etc.) manipulates the master's playlist or shuffle list. *See, e.g.,* (v5.3.1) Slim::Player::Playlist::shuffle(), Slim/Player/Playlist.pm (v5.3.1), 62-73 at 66; Slim::Player::Playlist::repeat(), Slim/Player/Playlist.pm (v5.3.1), 75-86 at 79; Slim::Player::Playlist::removeTrack(), Slim/Player/Playlist.pm (v5.3.1), 105-144 at 121, 134;

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Slim::Player::Playlist::removeMultipleTracks(), Slim/Player/Playlist.pm (v5.3.1), 146-217 at 160, 168, 170, 191, 206; Slim::Control::Command::insert\_done(), Slim/Control/Command.pm (v5.3.1), 801-821 at 811-813.

```
# fractional progress (0 - 1.0) of playback in the current song.
sub progress {

    my $client = Slim::Player::Sync::masterOrSelf(shift);

    my $songduration = $client->songduration();

    return 0 unless $songduration;
    return songTime($client) / $songduration;
}
```

Slim/Player/Source.pm (v5.3.1)

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```

sub songTime {

    my $client = Slim::Player::Sync::masterOrSelf(shift);

    # this used to check against == 1, however, we can't properly
    # calculate duration for non-native formats (pcm, mp3) unless we treat
    # the file as streaming. do this for all files right now.
    if ($client->audioFilehandleIsSocket()) {

        my $startTime = $client->remoteStreamStartTime();
        my $endTime = $client->pauseTime() || Time::HiRes::time();

        if ($startTime) {
            return $endTime - $startTime;
        } else {
            return 0;
        }
    }

    my $songLengthInBytes = $client->songtotalbytes();
    my $duration = $client->songduration();
    my $byterate = $duration ? ($songLengthInBytes / $duration) : 0;

    my $bytesReceived = ($client->bytesReceived() || 0) - $client->bytesReceivedOffset();
    my $fullness = $client->bufferFullness() || 0;
    my $realpos = $bytesReceived - $fullness;
    my $rate = $client->rate();
    my $startStream = $client->songStartStreamTime();

    #
    if ($realpos < 0) {
        $::d_source && msg("Negative position calculated, we are still playing out the previous
song.\n");
        $::d_source && msg("realpos $realpos calculated from bytes received: " .
            $client->bytesReceived() .
            " minus buffer fullness: " . $client->bufferFullness() . "\n");

        $realpos = 0;
    }

    my $songtime = $songLengthInBytes ? (($realpos / $songLengthInBytes * $duration * $rate) +
$startStream) : 0;

    if ($songtime && $duration) {
        $::d_source && msg("songTime: [$songtime] = ($realpos(realpos) / $songLengthInBytes(size) *
".
            "$duration(duration) * $rate(rate)) + $startStream(time offset of started stream)\n");
    }

    return $songtime;
}

```

Slim/Player/Source.pm (v5.3.1)

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```

sub currentSongIndex {
  my $client = shift;
  my $newindex = shift;

  $client = Slim::Player::Sync::masterOrSelf($client);

  if (defined($newindex)) {
    $client->currentsong($newindex);
  }

  return $client->currentsong() || 0;
}

```

Slim/Player/Source.pm (v5.3.1)

560. When a new client is added to a sync group, the new client is generally configured as a slave to the current master. As an exception, the new client is itself made the master if the current master is silent (to avoid having any silent masters). When the new client is added as a slave, the new client is jumped to the current position in the sync group's play list. *See, e.g.,* (v5.3.1) Slim::Player::Sync::sync(), Slim/Player/Sync.pm (v5.3.1), 132-167.

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```

# sync a given client to another client
sub sync {
  my $client = shift;
  my $buddy = shift;

  $::d_sync && msg($client->id() . ": syncing\n");

  if (isSynced($client) && isSynced($buddy) && master($client) eq master($buddy)) {
    return; # we're already synced up!
  }

  unsync($client);

  $buddy = masterOrSelf($buddy);

  # if the buddy is silent, switch them, so we don't have any silent masters.
  if (Slim::Utils::Prefs::clientGet($buddy,'silent')) {
    ($client, $buddy) = ($buddy, $client);
  }

  msg($buddy->id . " is silent and we're trying to make it a master!\n") if
  (Slim::Utils::Prefs::clientGet($buddy,'silent'));

  $client->master($buddy);

  push (@{$client->master->slaves}, $client);

  if (Slim::Player::Source::playmode($buddy) eq "play") {
    Slim::Control::Command::execute($client, ["playlist", "jump", "+0"]);
  }

  # Save Status to Prefs file
  saveSyncPrefs($client,$buddy);

  Slim::Control::Command::executeCallback($client, ['playlist','sync']);
}

```

Slim/Player/Sync.pm (v5.3.1)

561. Playing a song causes the new song to be opened on the master and played with the master's stream format. See, e.g., (v5.3.1) Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285-438 at 294, 334-335, 388-393.

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```

# playmode - start playing, pause or stop
sub playmode {
  my ($client, $newmode) = @_;

  assert($client);

  # Short circuit.
  return _returnPlayMode($client) unless defined $newmode;

  my $master = Slim::Player::Sync::masterOrSelf($client);

```

Slim/Player/Source.pm (v5.3.1)

```

# if we're playing, then open the new song the master.
if ($newmode eq "play") {

  # if the player is off, we automatically power on when we start to play
  if (!$client->power()) {
    $client->power(1);
  }

  # if we couldn't open the song, then stop...
  my $opened = openSong($master) || do {

    $::d_source && msg("Couldn't open song. Stopping.\n");

    $newmode = 'stop' unless openNext($client);
  };

  $client->bytesReceivedOffset(0);
}

```

Slim/Player/Source.pm (v5.3.1)

```

} elsif ($newmode eq "play") {

  $everyclient->readytosync(0);
  $everyclient->volume($client->volume(), 1);
  $everyclient->streamBytes(0);
  $everyclient->play(Slim::Player::Sync::isSynced($everyclient), $master->streamformat());

```

Slim/Player/Source.pm (v5.3.1)

562. When a client needs to read a new song chunk, the next chunk is read from the master (e.g., by reading from the master's audio file handle). See, e.g., (v5.3.1) Slim::Player::Source::nextChunk(), Slim/Player/Source.pm (v5.3.1), 476-519 at 489-491; Slim::Player::Source::readNextChunk(), Slim/Player/Source.pm (v5.3.1), 1257-1431 at 1327,

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1328, 1341, 1377.

```

sub nextChunk {
  my $client = shift;
  my $maxChunkSize = shift;

  my $chunk;

  # if there's a chunk in the queue, then use it.
  if (scalar(@{$client->chunks})) {

    $chunk = shift @{$client->chunks};

  } else {
    #otherwise, read a new chunk
    my $readfrom = Slim::Player::Sync::masterOrSelf($client);

    $chunk = readNextChunk($readfrom, $maxChunkSize);

    if (defined($chunk)) {

      # let everybody I'm synced with use this chunk
      foreach my $buddy (Slim::Player::Sync::syncedWith($client)) {
        push @{$buddy->chunks}, $chunk;
      }
    }
  }
}

```

Slim/Player/Source.pm (v5.3.1)

```

sub readNextChunk {
  my $client = shift;
  my $givenChunkSize = shift;

```

Slim/Player/Source.pm (v5.3.1)



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```

        if ($client->streamformat() eq 'mp3') {
            ($seekpos, undef) = Slim::Formats::MP3::seekNextFrame($client->audioFilehandle(),
$seekpos, 1);
            my (undef, $endsegment) = Slim::Formats::MP3::seekNextFrame($client-
>audioFilehandle(), $seekpos + $tricksegmentbytes, -1);

            if ($seekpos == 0 || $endsegment == 0) {
                $endofsong = 1;
                $::d_source && msg("trick mode couldn't seek: $seekpos/$endsegment\n");
                goto bail;
            } else {
                $tricksegmentbytes = $endsegment - $seekpos + 1;
            }
        }

        $::d_source && msg("new trick mode segment offset: $seekpos for
length:$tricksegmentbytes\n");

        $client->audioFilehandle->sysseek($seekpos, 0);
        $client->songBytes($client->songBytes() + $seekpos - $now);
        $client->trickSegmentRemaining($tricksegmentbytes);

```

Slim/Player/Source.pm (v5.3.1)

```

if ($chunksize > 0) {

    my $readlen = $client->audioFilehandle()->sysread($chunk, $chunksize);

```

Slim/Player/Source.pm (v5.3.1)

563. Jumping to a particular time in the current song operates on the master using the master's song and audio file handle. The slaves are updated with the new position. *See, e.g.,* (v5.3.1) Slim::Player::Source::gototime(), Slim/Player/Source.pm (v5.3.1), 521-602 at 528, 533, 578-601.

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```

#
# jump to a particular time in the current song
# should be dead-on for CBR, approximate for VBR
# third argument determines whether this is an instant jump or wait until the
# buffer gets around to it
#
sub gototime {
    my $client = Slim::Player::Sync::masterOrSelf(shift);
    my $newtime = shift;

    return unless Slim::Player::Playlist::song($client);

    if (!defined $client->audioFilehandle()) {
        return unless openSong($client);
    }

    my $songLengthInBytes = $client->songtotalbytes();
    my $duration          = $client->songduration();

```

Slim/Player/Source.pm (v5.3.1)

```

foreach my $everybuddy ($client, Slim::Player::Sync::slaves($client)) {
    $::d_source && msg("gototime: stopping playback\n");
    next if (Slim::Utils::Prefs::clientGet($everybuddy, 'silent'));
    $everybuddy->stop();
    @{$everybuddy->chunks} = ();
}

my $dataoffset = $client->songoffset();

$client->songBytes($newoffset);
$client->songStartStreamTime($newtime);

$client->audioFilehandle()->sysseek($newoffset + $dataoffset, 0);

foreach my $everybuddy ($client, Slim::Player::Sync::slaves($client)) {
    next if (Slim::Utils::Prefs::clientGet($everybuddy, 'silent'));

    $::d_source && msg("gototime: restarting playback\n");

    $everybuddy->readytosync(0);

    $everybuddy->play(Slim::Player::Sync::isSynced($client), $client->streamformat());
}
}

```

Slim/Player/Source.pm (v5.3.1)

564. The foregoing is consistent with the Court's Order, which does not require the indication to include the identity of each zone player within the zone scene. Instead, zone players

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within the zone scenes may coordinate using a leader-follower protocol as disclosed in the Squeezebox system as opposed to a direct coordination system implied by having each zone player maintain group membership. *E.g.*,

Slim/Player/Source.pm	
482	# if there's a chunk in the queue, then use it.
483	if (scalar(@{\$client->chunks})) {
484	
485	\$chunk = shift @{\$client->chunks};
486	
487	} else {
488	#otherwise, read a new chunk
489	my \$readfrom = Slim::Player::Sync::masterOrSelf(\$client);
490	
491	\$chunk = readNextChunk(\$readfrom, \$maxChunkSize);
492	
493	if (defined(\$chunk)) {
494	
495	# let everybody I'm synced with use this chunk
496	foreach my \$buddy (Slim::Player::Sync::syncedWith(\$client)) {
497	push @{\$buddy->chunks}, \$chunk;
498	}
499	}
500	}

565. To the extent Dr. Almeroth finds that the above does not reflect leader-follower coordination, I note, consistent with the Court's statements that the "indication" does not require a zone player communicating with other speakers present in the group, that there is similarly no requirement that the zone player being "configured to coordinate" communicate *directly* with other zone players. In my opinion, Squeezebox communications via the SlimServer would also meet the claim requirements for similar reasons.

#### (b) Obviousness – Sonos Forums

566. It would also have been obvious to modify the Squeezebox to add this claim limitation, to the extent it is not disclosed. For example, the Sonos Forums described *supra* (and

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fully incorporated herein by reference), disclose the “macro” / “zone scene” Sonos allegedly invented. Below are two individual posts describing the “zone scenes” under Sonos’s construction, but the voluminous posts from the Sonos Forums excerpted above further describe this functionality.

### Macro / presets

16 years ago • 61 replies

 JeffT


Just got the intro bundle, and I am impressed. I did a search and did not find this suggested, but I would save Zone links as favorites. With only 2 ZPs it is not a problem yet, but when I add more it maybe. I would like to setup say Morning mode for the units I want in the morning and a preset volume between the units. Another example I would have 2 party modes, Summer and Winter. The Summer mode would include the deck speakers and the Winter mode would not. Also it would be nice to have playlists or radio station associated with each mode. So when I get up I press Morning the DI Chill radio station plays.

Jeff

Farrar Dep. Ex. 6 at 1.

### Virtual Zones and Zone Grouping

17 years ago • 190 replies


 theboyg




This "link/unlink" business is really cumbersome - and not a joy to use which goes against the ease of use of the rest of the system.

Why can't I have a virtual zone - ie a zone called "Downstairs" - and I can group all my downstairs zones into this. Then I dont have to keep manually linking/unlinking multiple zones everytime.

PLEASE !

G.

 2 people like this

**Exhibit  
0008**

Farrar Dep. Ex. 8 at 1.

567. As Mr. Lambourne testified, the users requesting “virtual zones” and “macro” or “preset” groups disclosed the “zone scene” concept. Lambourne Dep. Tr. at 131 (“Q. Did your invention address the concerns of these users through adding Zone Scenes? THE WITNESS: Yes. My invention would describe the need described here. Q. Why is that? A. By allowing a user to

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save zone groupings or linking, as being referred to here.”) (objections omitted). The named and saved groups also meet Sonos’s requirements that for a group to be a “zone scene” that it must be named and saved and play back music synchronously because the zone linking/macro functionality described in the Sonos Forums was describing the synchronous playback already found in the Sonos System (and as described in the invalidity ground below). The “virtual zones” and “macros” save the groups, as shown in those forum posts, and the users are attributing names to them like “Downstairs.”

**(c) Obviousness – Nourse**

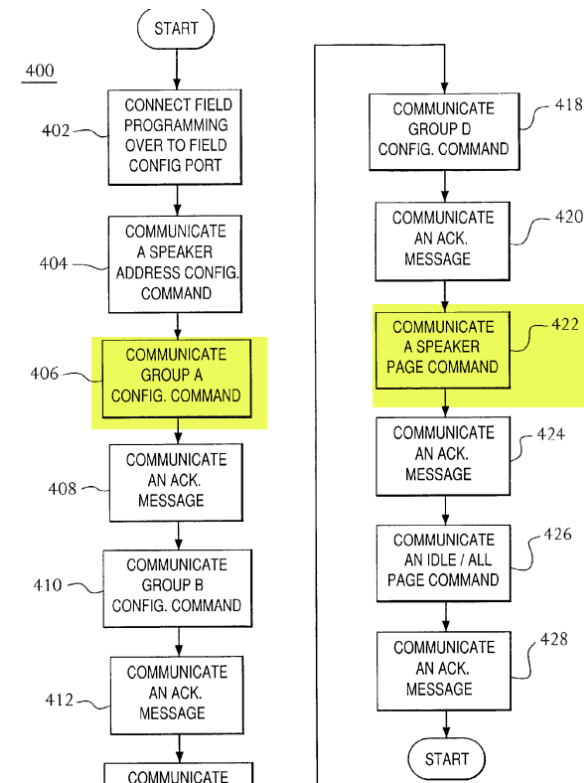
568. To the extent it is found that the Logitech/Squeezebox system did not explicitly disclose a “zone scene,” with the ability to pre-save (and name) customized speaker groups and later “invoke” the named group on demand (*i.e.*, a “zone scene” under the Court’s construction), such features would have been obvious to a person of skill in the art, in view of at least Nourse. Nourse discloses a conventional “centralized speaker system that allows multiple speakers connected to a centralized amplifier speaker line to be monitored and controlled from a central location via a master/slave protocol.” Nourse at Abstract; *see also, e.g., id.* at 2:18-20 (“In accordance with the present invention, a speaker system is provided having distributed speakers and amplifiers and centralized speaker monitoring and command control.”), FIG. 1.

569. Nourse discloses the ability to have overlapping zone groups, with one speaker being part of two groups at the same time. *See, e.g.,* Nourse at 3:57:60 (“Each of the plurality of speakers 152 preferably has a unique 16-bit address. Each of the plurality of speakers 152 can further be assigned up to four group identifiers (IDS).”), 4:4-5 (“first speaker 152, can be assigned to more than one group”), 4:11-13 (“up to 16 master controls units 102 can be controlled individually and/or simultaneously via the computer 154 using the master control unit 102 addresses.”). A person of skill in the art at the time of the alleged invention working with the

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Logitech System would have found it obvious to look to other “centralized speaker system[s]” for ways to improve the zone scenes (as described by the Court) within the Logitech System, such as by allowing overlapping groups.

570. Nourse also discloses the ability for a speaker to operate independently even after being added to a zone scene, as described in the Court’s Order. *See, e.g.*, 4:53-55 (“remote units 130 each monitor the incoming message from the master unit 102 to determine whether it is being addressed either as an individual unit or as part of a group”). This is disclosed in Nourse, for example in relation to Figure 4, reproduced below, where at step 406 “the field programming device communicates the Speaker Group A configured command to the remote unit 130” and later, while remote unit 130 is still in Group 1, “at step 422, the field programming device communicates a Speaker Page configure command to the remote unit 130.” Nourse at 7:37-39, 8:19-20.



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- 20. Limitation 1.7: “(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player;”**

571. In my opinion, Squeezebox discloses or renders obvious this claim limitation.

572. I incorporate by reference my discussion of Limitation 1.6 herein, which discloses receiving from a network device an indication that the zone player has been added to a zone scene comprising a predefined grouping of zone players that are to be configured for synchronous playback of media when the zone scene is invoked. Limitation 1.7 adds the limitation that the first zone player is a member of two different “zone scenes.”

573. The SlimServer configuration, including the definitions of the sync groups, is stored into a preferences file. However, a single player may be defined in separate sync groups on different SlimServer configurations, persisted to different preferences files. As one example, a player may be used with different servers, which define different sync groups and persist to different preferences files. One example (v6.2.1) is using a player both with a local SlimServer and with the SqueezeNetwork. As another example, a player may be used with different invocations of the same server. Each invocation uses a different preference file, specified on the command line using the '--prefsfile' option.



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**How do I synchronize two Squeezeboxes so they play the same audio?**

Navigate into the Player Settings area with the remote control. Choose Synchronize, then select the other player you want to synchronize with and press the RIGHT button. Both will play the same thing and you can control their synchronized playback from either remote. Go back to the same place and press RIGHT again to unsync.

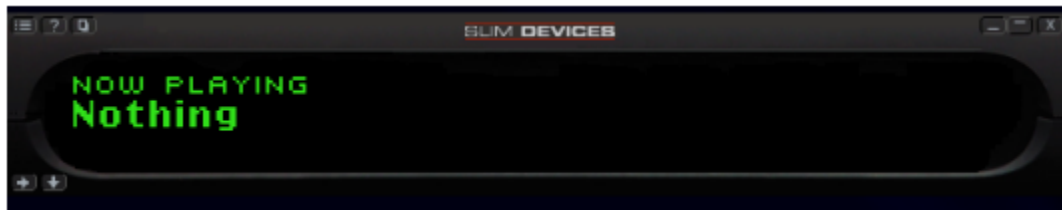
You can also set up synchroniziation from the Player Settings page in the web interface.

[http://<SLIMSERVER\\_ADDR>:9000/html/docs/faq.html?player=#setup-preferencefile](http://<SLIMSERVER_ADDR>:9000/html/docs/faq.html?player=#setup-preferencefile) →  
HTML/EN/faqquestions.html →  
Home / Frequently Asked Questions

574. Depending on configuration, the Squeezebox/SlimServer system can separate sync group definition from active sync group participation with respect to powered-off players.

575. A Squeezebox player, including SoftSqueeze, can be commanded by SlimServer to power on or off. The “power off” status does not reflect the player being fully powered off (at least for SoftSqueeze). Instead, the player enters a dormant state and can be commanded to power back on.

576. For example, a player that is powered on but in the STOP state displays an active screen (e.g., Now Playing) at normal brightness:



577. When powered off, the player displays the date and time at a dimmed brightness.



578. In the Squeezebox/SlimServer system, a player may be configured to power on/off either independently of its sync group or together with all the other players in its sync group.

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### Synchronize Power

You can choose to have this player turn off on its own, or turn off as a group with all other players in the group. Make a selection below and click Change.

Power off/on separately 

Change

`http://<slimserver_addr>:9000/setup.html?page=audio&player=<PLAYER>&playerid=<PLAYER_ID>`

Home / Player Settings / Audio

SETUP\_SYNC\_POWER\_DESC, strings.txt (v5.3.1), 1518–1523

579. A powered-off player is temporarily unsynced but still defined to be part of the persistent sync group. Because a player can be configured to turn on/off independently of its sync group, a persistently defined sync group may include players that are powered off and not actively participating in a sync group. A powered-off player is "temporarily" unsynced from its sync group. *See, e.g.,* (v5.3.1): Error rendering macro 'code': Invalid value specified for parameter 'com.atlassian.confluence.ext.code.render.InvalidValueException:

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```

        , 'syncPower' => {
            \&validateTrueFalse
            ('SETUP_SYNCPOWER_ON')
            string('SETUP_SYNCPOWER_OFF')

            ($client, $changeref, $paramref, $pageref) = @_;
            ($client));
            $changeref->{'syncPower'}{'new'};
            Player::Sync::syncedWith($client);
            > 0) {
                $eachclient (@buddies) {
                    (!$value && !$eachclient->power()) {
                        #temporarily unsync off players if on/off set to separate
                        Slim::Player::Sync::unsync($client, 1);

                        Slim::Utils::Prefs::clientSet($eachclient, 'syncPower', $value);
                    }
                }
            }
        }
    }
}

```

Slim::Web::Setup::initSetupConfig(), Slim/Web/Setup.pm (v5.3.1), 103–2118 at 951–972

## Slim/Buttons/Power.pm (v5.3.1)

```

sub setMode {
    my $client = shift;
    $client->lines(\&lines);
    my $sync = Slim::Utils::Prefs::clientGet($client, 'syncPower');
    if (defined $sync && $sync == 0) {
        $::d_sync && Slim::Utils::Misc::msg("Temporary Unsync ".$client->id()."\n");
        Slim::Player::Sync::unsync($client, 1);
    }

    if (Slim::Player::Source::playmode($client) eq 'play' && Slim::Player::Playlist::song($client)) {
        if (Slim::Music::Info::isRemoteURL(Slim::Player::Playlist::song($client))) {
            Slim::Control::Command::execute($client, ["stop"]);
        } else {
            Slim::Control::Command::execute($client, ["pause", 1]);
        }
    }

    # switch to power off mode
    # use our last saved brightness
    $client->brightness(Slim::Utils::Prefs::clientGet($client, "powerOffBrightness"));
    $client->update();
}

```

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580. When a non-master player is temporarily unsynced from its group, it is removed from the master/slave data structures in dynamic memory. The player is removed from the master's list, and the player's 'master' property is set to undefined.

**Slim/Player/Sync.pm (v5.3.1)**

```

    } elsif (isSlave($client)) {
        # if we're a slave, remove us from the master's list
        my $i = 0;
        foreach my $c (@{$$client->master()->slaves}) {
            if ($c->id() eq $client->id()) {
                splice @{$client->master->slaves}, $i, 1;
                last;
            }
            $i++;
        }

        # and copy the playlist to the now freed slave
        my $master = $client->master;
        Slim::Player::Playlist::copyPlaylist($client, $master);

        $client->master(undef);
    }

```

Slim::Player::Sync::unsync(), Slim/Player/Sync.pm (v5.3.1), 62–130 at 105–121

581. However, the temporary unsync is not recorded to the preferences file. The saveSyncPrefs() method is invoked with 1 for the \$temp argument, which causes its syncgroupid to be retained ("Idling Sync") rather than deleted.

**Slim/Player/Sync.pm (v5.3.1)**

```

    # when we unsync, we stop, but save settings first if we're doing at temporary unsync.
    if ($temp) {
        saveSyncPrefs($client, defined $temp);
        Slim::Control::Command::execute($client, ["stop"]);
    } else {
        Slim::Control::Command::execute($client, ["stop"]);
        saveSyncPrefs($client, defined $temp);
    }

```

Slim::Player::Sync::unsync(), Slim/Player/Sync.pm (v5.3.1), 62–130 at 122–129

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#### Slim/Player/Sync.pm

```

    if ($temp) {
        $::d_sync && msg("Idling Sync for $clientID\n");
    } else {
        $client->syncgroupid(undef);
        Slim::Utils::Prefs::clientDelete($client, 'syncgroupid');
        $::d_sync && msg("Clearing Sync master for $clientID\n");
    }

```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 169–194 at 187–193

582. When a player is powered on, it is restored to its sync group.

#### Slim/Player/Player.pm (v5.3.1)

```

#check if there is a sync group to restore
Slim::Player::Sync::restoreSync($client);

```

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 230–231

#### Slim/Player/Sync.pm (v5.3.1)

```

# Restore Sync Operation
sub restoreSync {
    my $client = shift;
    my $masterID = (Slim::Utils::Prefs::clientGet($client, 'syncgroupid'));
    if ($masterID && $client->power()) {
        my @players = Slim::Player::Client::clients();
        foreach my $other (@players) {
            next if ($other eq $client);
            next if (!$other->power());
            my $othermasterID = Slim::Utils::Prefs::clientGet($other, 'syncgroupid');
            if ($othermasterID && ($othermasterID eq $masterID)) {
                $client->syncgroupid($masterID);
                $other->syncgroupid($masterID);
                sync($client, $other);
                last;
            }
        }
    }
}

```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 196–214

583. Consider the following set of three SoftSqueeze players, where player1, player2, and player3 are all synchronized together and player 1 is the master.

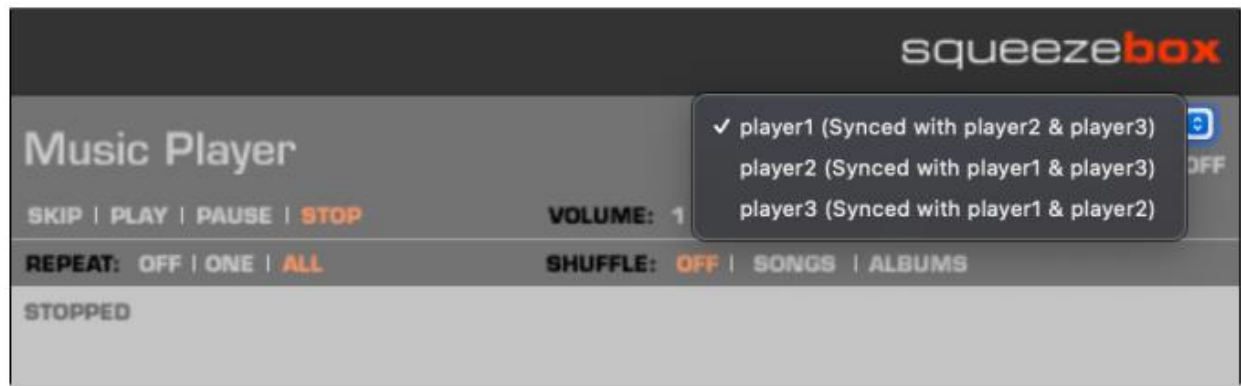
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Name	MAC (client ID)	IP	syncgroupid
player1	bc:39:f3:c4:1e:29	192.168.136.129	482986368
player2	0f:59:51:64:dc:d7	192.168.136.130	482986368
player3	51:93:a5:ad:53:20	192.168.136.131	482986368

584. The preferences file (slimserver.conf) shows all players in the same sync group (482986368), as shown by the following 'grep' search of the preferences file.

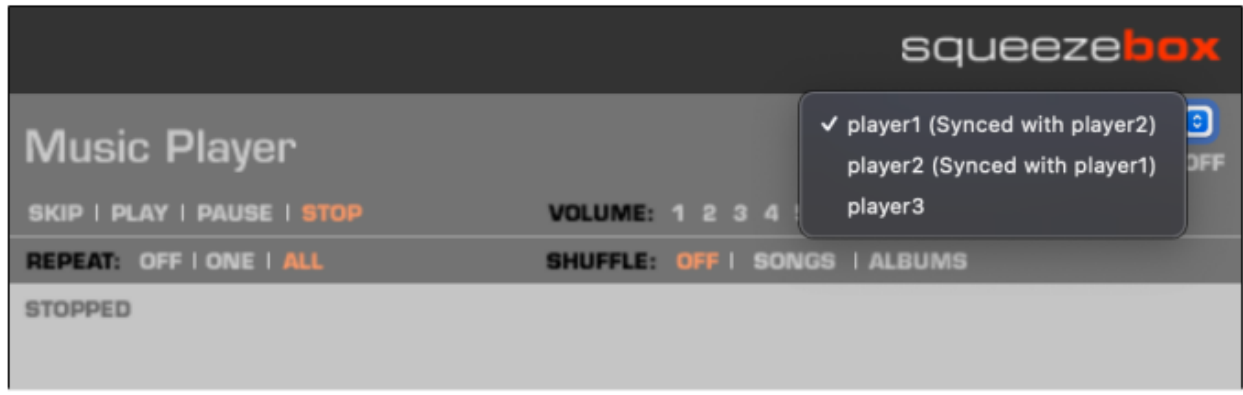
```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

585. When all three players are powered on, the Web UI shows player1 synchronized with player2 and player3.

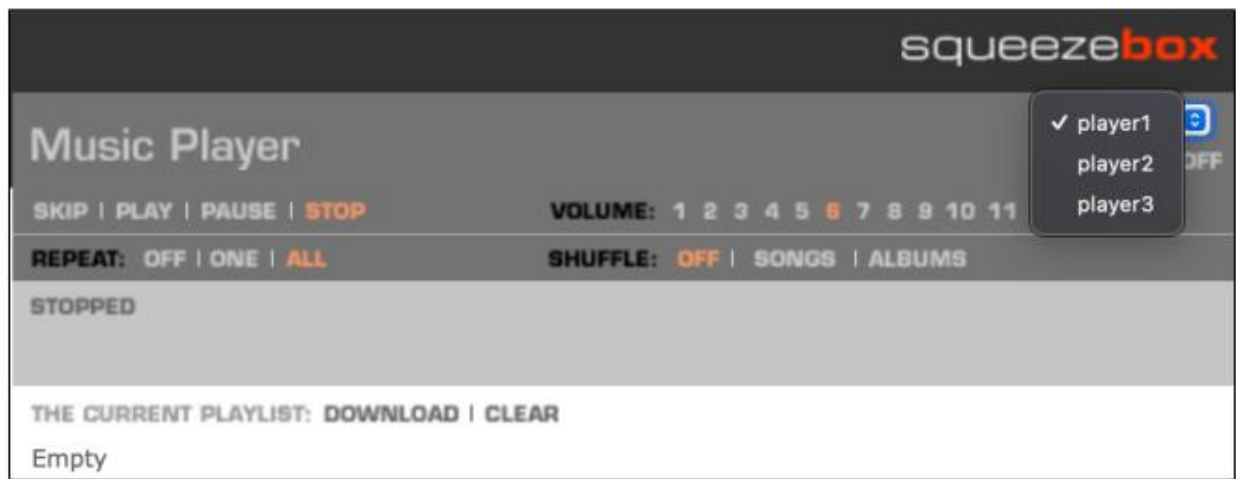


586. After pressing the "OFF" button in the Web UI's Music Player pane to power off player3, the Web UI shows player1 and player2 still synced, but player3 is unsynced.

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587. After pressing the "OFF" button in the Web UI's Music Player pane to power off player2, the Web UI shows all players as unsynced.



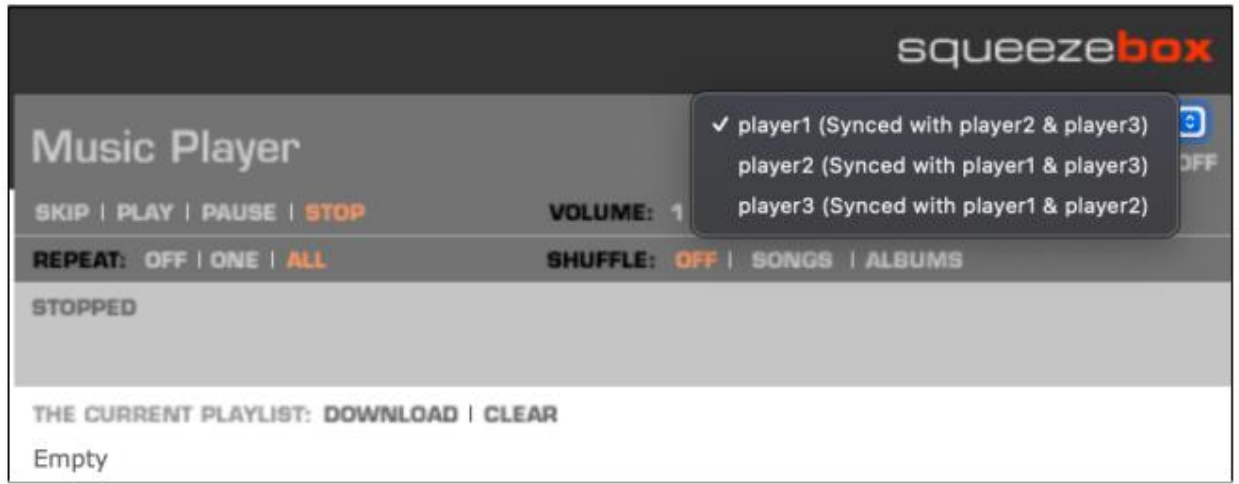
588. Although all players are treated as unsynced when only player1 is on, the preferences file still shows all three players in the same sync group.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

589. After powering on player2 and player3, the Web UI shows all three players synchronized again.



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590. SlimServer v6.2.1 supports a 'serv' SlimProto message from SlimServer to player that tells a player to switch servers.

591. In SlimServer v6.2.1, the 'serv' SlimProto message is only used to tell the player to switch to SqueezeNetwork. The 'serv' message is sent with a host value of 1, representing SqueezeNetwork.

#### Slim/Buttons/SqueezeNetwork.pm (v6.2.1)

```
sub connectSqueezeNetwork {
    my $client = shift;

    # don't disconnect unless we're still in this mode.
    return unless ($client->param('squeezenetwrok.connect'));

    if (clientIsCapable($client)) {
        my $host = pack('N',1); # 1 is squeezenetwrok
        $client->sendFrame('serv', \$host);

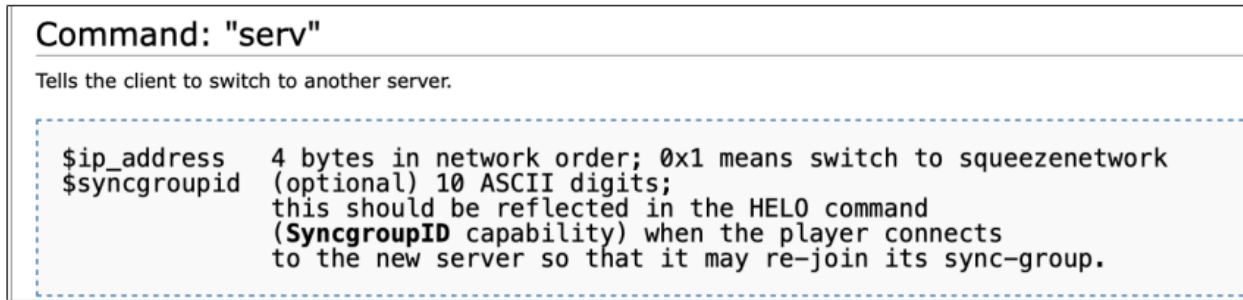
        # TODO: ensure client actually received the message

        # if message recieved, client has disconnected
        $client->forgetClient();
    }
}
```

Slim::Buttons::SqueezeNetwork::connectSqueezeNetwork(), Slim/Buttons/SqueezeNetwork.pm (v6.2.1), 90–105 at 97–98

592. The SlimProto TCP Protocol documentation on the current Squeezebox Wiki describes a later version of the 'serv' message.

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593. The function of the 'serv' command is described as: "Tells the client to switch to another server." The later version of 'serv' still supports the value of 1 to represent SqueezeNetwork but can also take a four-byte IP address to specify the server. In addition, the later command supports a '\$syncgroupid' optional parameter to enable a player to re-join its sync group when the player connects to the new server. As discussed below, switching servers was possible prior to the serv command or the explanation above.

594. I now discuss an example use of the Squeezebox system that helps to illustrate the functionality of that system with respect to at least claim limitations 1.6-1.10. I note that this example uses VMs and SoftSqueeze, but that my testing of the hardware Squeezebox confirms that the same setup is available through Squeezeboxes, including my setup of SlimServers and Squeezeboxes over Wi-Fi.

595. In this example, all VMs are configured with a private network, which has network address 192.168.136.0/24.

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Name	Network MAC	Player MAC	IP
slimserver1	00:0C:29:A3:52:C6		192.168.136.128
slimserver2	00:0C:29:3B:B5:D2		192.168.136.135
player1	00:0C:29:45:6F:C2	db:3a:52:e6:70:6b	192.168.136.129
player2	00:0C:29:83:57:01	19:1e:67:04:72:30	192.168.136.130
player3	00:0C:29:B2:5E:60	bc:2a:ae:6b:ab:ce	192.168.136.131

596. I note that the Player MAC is determined by SoftSqueeze and is different from the network MAC of the computer running SoftSqueeze.

597. We begin with a fresh installation of SlimServer v5.3.1 on all SlimServer VMs (slimserver1 and slimserver2), accomplished by uninstalling and then re-installing the SlimServer RPM.

```
rpm -e slimserver
rpm -ivh slimserver-5.3.1-1.noarch.rpm
```

598. Then set up Music Folder on slimserver1 and slimserver2 to /mnt/hgfs/Music.

599. On slimserver1 and slimserver2, let the default server installations run automatically. The default configuration stores the preferences file in /etc/slimserver.conf and the log file in /tmp/slimserver.log.

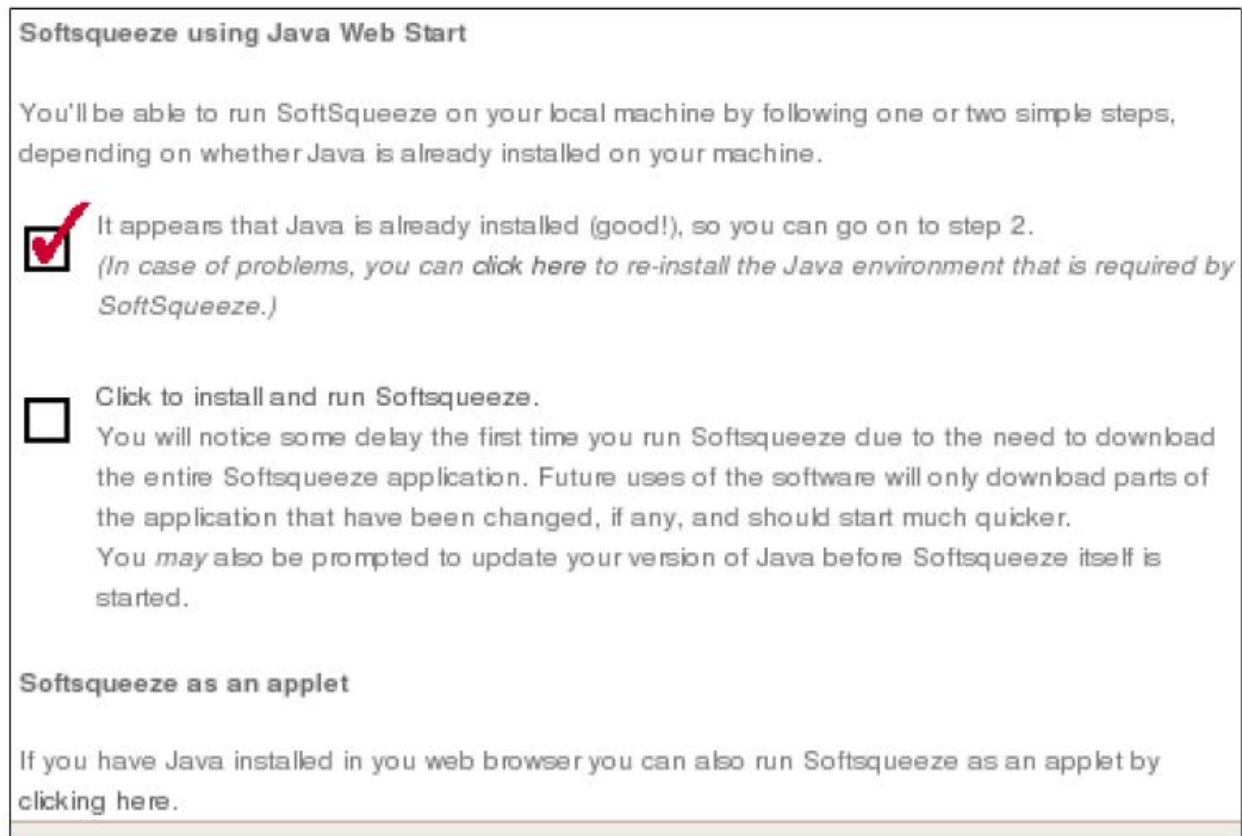
600. On player VMs, remove all Java user preferences.

```
rm -rf ~/.java/.userPrefs
```

601. We follow the directions given by the SlimServer Web UI to launch SoftSqueeze from the web browser. This is equivalent to the direct invocation. We use the browser launch here to more directly follow the instructions given by SlimServer. I note that even though the player is being launched using one SlimServer (e.g., slimserver1), the player can stay running and

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connect to other SlimServers (e.g., slimserver2). Alternatively, we can directly run the JAR file using "java -jar SoftSqueeze.jar" (independently of any running SlimServer instance) as previously done.



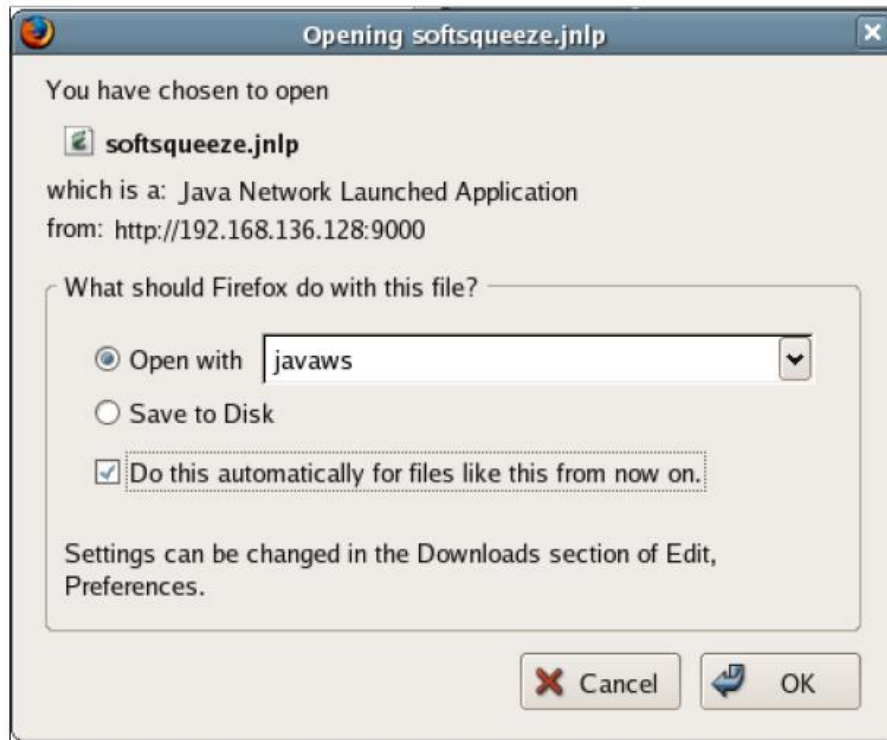
[http://<SLIMSERVER\\_ADDR>:9000/html/SoftSqueeze/index.html?player=0f%3A59%3A51%3A64%3Adc%3Ad7](http://<SLIMSERVER_ADDR>:9000/html/SoftSqueeze/index.html?player=0f%3A59%3A51%3A64%3Adc%3Ad7)

Home / SoftSqueeze

HTML/EN/html/SoftSqueeze/index.html

602. When prompted, use javaws (\$JAVA\_HOME/bin/javaws) to open the SoftSqueeze.jnlp file:

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603. When prompted, select always trusting the application:



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604. The SoftSqueeze player launches and connects to the server automatically (e.g., by discovery).

605. Using the Web UI, configure the player names. For example:

**Player Name**  
 You can give this player a name that will be used to identify the player on these web pages.  
 Player name:

[http://<SLIMSERVER\\_AP>:9000/setup.html?page=player&player=bc%3A2a%3Aae%3A6b%3Aab%3Ace&playerid=db%3A3a%3A52%3Ae6%3A70%3A6b](http://<SLIMSERVER_AP>:9000/setup.html?page=player&player=bc%3A2a%3Aae%3A6b%3Aab%3Ace&playerid=db%3A3a%3A52%3Ae6%3A70%3A6b)  
 Home / Player Settings

606. After all player names have been configured, the Web UI shows the player names:

**SETTINGS**  

- Server Settings
- Player Settings for player1
- Player Settings for player2
- Player Settings for player3

[http://<SLIMSERVER\\_ADDR>:9000/index.html?player=db:3a:52:e6:70:6b](http://<SLIMSERVER_ADDR>:9000/index.html?player=db:3a:52:e6:70:6b)  
 Home

607. Using the Web UI, press the "OFF" button to power off all players. For example, after turning off player1:

[http://<SLIMSERVER\\_ADDR>:9000/index.html?player=db:3a:52:e6:70:6b](http://<SLIMSERVER_ADDR>:9000/index.html?player=db:3a:52:e6:70:6b)  
 Home

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608. At this point, all players are persisted to slimserver1's preferences file with the defined names (player1, player2, and player3), power synchronization "off" (0), no sync groups, and power state "off" (0).

```
[vmuser@slimserver1 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 0
db:3a:52:e6:70:6b-syncPower = 0
```

609. I then define the first sync group on slimserver1. First I set up the logging and network trace for testing purposes. Stop slimserver1, clear the slimserver1 log file, and then start slimserver1. A new log file will be started in /tmp/slimserver.log

```
/etc/rc.d/init.d/slimserver stop
rm /tmp/slimserver.log
/etc/rc.d/init.d/slimserver start
```

610. When slimserver1 restarts, all connected players are powered on. Power all players off using the Web UI. In Home / Server Settings / Debugging, turn on debugging settings related to SlimProto. As a result, information about SlimProto protocol operation is logged to the log file (/tmp/slimserver.log).

<input type="checkbox"/> d_server	Change
<input checked="" type="checkbox"/> d_slimproto	Change
<input checked="" type="checkbox"/> d_slimproto_v	Change
<input type="checkbox"/> d_source	Change

611. Start a network trace.

```
tcpdump -i eth0 -s 0 -w slimserver1-01.pcap
```



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612. We then define the first sync group. Press the right-arrow icon at the bottom-left of the SoftSqueeze player1 to show the remote control.



613. Press the power button to power player1 back up and allow for interaction. The player briefly shows the welcome screen and then transitions to the home screen.



614. Press up arrow to switch to the "Settings" menu item.

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615. Press right arrow to select "Settings" and show the first Settings menu item ("Alarm Clock," setting 1 of 13).



616. Press up arrow to switch to the "Synchronize" menu item (setting 13 of 13).

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617. Press right arrow to select "Synchronize" and show a first synchronization choice (player3).



618. Press up arrow to show another synchronization choice (player2).

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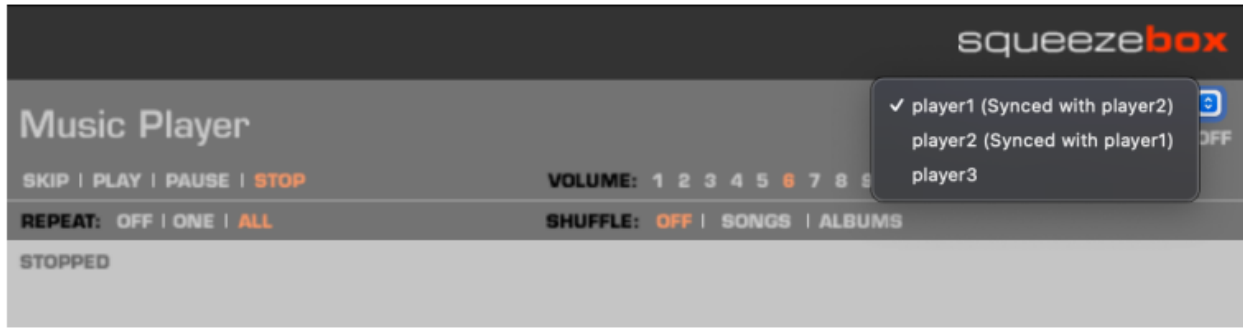


619. Press right arrow to select synchronization with player2. The screen changes to show that player2 is synced, with the menu choice now representing a choice to unsync. The screen change is animated, with the new screen pushing the old screen to the left.



620. The Web UI shows player1 and player2 synced.

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621. slimserver1's preferences file shows player1 and player2 defined in the same sync group (675042355). player1 is powered on. player2 and player3 are powered off.

```
[vmuser@slimserver1 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
19:1e:67:04:72:30-syncgroupid = 675042355
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncgroupid = 675042355
```

622. As shown above, synchronizing player1 with player3 involves a series of remote control inputs and player1 screens. Both the remote control inputs and resulting screens involve SlimProto network messages between slimserver1 and player1.

- player1 sends "IR " SlimProto messages to slimserver1 for each IR events, such as button presses.
- slimserver1 sends "grfd" SlimProto messages to to player1 to display graphical screens

623. We first identify the IR SlimProto messages, which send IR codes from the player to the SlimServer. From the identified IR messages, the last "right arrow" IR packet represents the "right arrow" button press that initiates sync for player1 and player2. An IR packet is a client-to-server message, which consists of:

- Operation ("IR ") — offset 0, four bytes
- Data Packet Length — offset 4, four bytes

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- Time — offset 8, four bytes
- Format — offset 12, one byte
- NoBits — offset 13, one byte
- IRCode — offset 14, four bytes

**Client -> Server Communications**

A command to the server consists of three parts:

1. The 1st 4 bytes specify the operation. The following operations are supported:
  - HELO
  - IR (note the two spaces after IR)
  - RESP
  - STAT
  - BYE!
2. The 2nd part (of four bytes) is simply the length of the data packet (in Network order).
3. The 3rd part is the data itself.

**"IR "** (Note the two spaces to make it up to 4 characters.)

One of these packets is recieved for each IR code recieved by the player.

**Data Length:** Fixed at 10 bytes.

**Format:**

Time	4 bytes	Time since player startup in ticks (@1Khz)
Format	1 byte	Code Format (ignored by the server for now - Code represents type of IR code - NEC, JVC or Sony)
NoBits	1 byte	Length of IR Code (ignored by the server for now - 16 bits for JVC, 32 bits for NEC?)
IRCode	4 bytes	the IR Code itself (upto 32 bits)

[http://<SLIMSERVER\\_ADDR>:9000/html/docs/slimproto.html](http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html)  
HTML/EN/html/docs/slimproto.html

624. The "arrow\_right" IR code is 7689d02f.

- arrow\_right, IR/Slim\_Devices\_Remote.ir (v5.3.1), 21

625. The "right arrow" IR SlimProto packets are then identified using a WireShark display filter that selects for:

- destination port 3483 — from player to SlimServer
- data that begins with "IR " — the IR type



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- data that has 0x7689d02f in the four bytes beginning at offset 14

626. which is expressed as:

```
tcp.dstport == 3483 && data.data[0:4] == "IR " && data.data[14:4] == 76:89:d0:2f
```

627. There are six matching network packets, clustered in groups of two (954/966, 1427/1437, and 1894/1904). Within a cluster, the packets occur very close in time (e.g., within 0.1 seconds for 954/966). Because the clustered IR packets are very close in time, an IR cluster is consistent with a button repeat sequence as handled by the SlimServer IR code.

## Slim/Hardware/IR.pm (v5.3.1)

```
if (($irCodeBytes eq ($client->lastircodebytes())) #same button press as last one
    && ( ($client->irtimediff < $Slim::Hardware::IR::IRMINTIME) #within the minimum time to be
considered a repeat
        || (($client->irtimediff < $client->irrepeattime * 2.02) #or within 2% of twice the
repeat time
            && ($client->irtimediff > $client->irrepeattime * 1.98))) #indicating that a
repeat code was missed
    ) {
        holdCode($client,$irCodeBytes);
        repeatCode($client,$irCodeBytes);
        if (!$client->irrepeattime || ($client->irtimediff > 0 && $client->irtimediff < $client-
>irrepeattime)) {
            #repeat time not yet set or last time diff less than current estimate
            #of repeat time (excluding time diffs less than 0, from out of order packets)
            $client->irrepeattime($client->irtimediff)
        }
    }
```

Slim::Hardware::IR::processIR(), Slim/Hardware/IR.pm (v5.3.1), 334–393 at 365–376

628. The three clusters represent the three "right arrow" presses performed in the synchronization flow described above. The first "right arrow" selects the "Settings" menu item, the second "right arrow" selects the "Synchronize" menu item, and the third "right arrow" selects the sync group to join. The last IR packet cluster (1894 at 20:48:16.074074; 1904 at 20:48:16.164760) thereby represents the "arrow\_right" IR code that initiates the sync.



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tcp.dstport == 3483 && data.data[0:4] == "IR " && data.data[14:4] == 76:89:d0:2f							
No.	Time	Source	Destination	Protocol	Source Port	Destination Port	Length
954	20:47:26.486498	192.168.136.129	192.168.136.128	TCP	32866	3483	84
966	20:47:26.583292	192.168.136.129	192.168.136.128	TCP	32866	3483	84
1427	20:47:51.009815	192.168.136.129	192.168.136.128	TCP	32866	3483	84
1437	20:47:51.101712	192.168.136.129	192.168.136.128	TCP	32866	3483	84
1894	20:48:16.074074	192.168.136.129	192.168.136.128	TCP	32866	3483	84
1904	20:48:16.164760	192.168.136.129	192.168.136.128	TCP	32866	3483	84

629. The slimserver1 log file is consistent with the network trace (modulo a slight time skew between the network stack timestamp and the application logging timestamp).

```
[vmuser@slimserver1 example]$ grep 'op IR ' slimserver-01.log
2022-06-21 20:46:58.1073 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:46:58.2000 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:11.1490 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:11.2416 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:26.4876 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:26.5846 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:38.8061 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:38.9095 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:51.0111 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:51.1028 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:02.0107 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:02.1029 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.0756 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.1657 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
```

630. After packet 1894 (20:48:16.074074), SlimServer responds with a series of eight 'grfd' command packets to the player animating the new screen pushing the old screen off to the left.

```
Slim/Player/SqueezeboxG (v5.3.1)

# push the old screen off the left side
sub pushLeft {
    my $client = shift;
    my $start = shift;
    my $end = shift;

    my $startbits = $client->render($start);
    my $endbits = $client->render($end);

    my $allbits = $$startbits . $$endbits;

    $client->killAnimation();
    $client->pushUpdate([\ $allbits, 0, $screensize / 8, $screensize, 0.025]);
}

```

Slim::Player::SqueezeboxG::pushLeft(), Slim/Player/SqueezeboxG.pm (v5.3.1), 401–414 at 413  
 Slim::Player::SqueezeboxG::pushUpdate(), Slim/Player/SqueezeboxG.pm (v5.3.1), 447–464 at 459

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Slim::Player::SqueezeboxG::drawFrameBuf(), Slim/Player/SqueezeboxG.pm (v5.3.1), 368–382 at 380

631. Each such packet begins with a two-byte length field and a four-byte command field. The 'grfd' are identified in the network trace using a WireShark display filter that selects for:

source port 3483 — from SlimServer to player  
 TCP length > 0 — to filter out pure acknowledgement packets  
 command code 'grfd'  
 destination 192.168.136.129 (player1)

```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129
```

tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129							
No.	Time	Source	Destination	Protocol	Source Port	Destination Port	Length
1859	20:48:13.294596	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1871	20:48:14.295306	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1883	20:48:15.295355	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1896	20:48:16.079013	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1898	20:48:16.104491	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1900	20:48:16.130371	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1902	20:48:16.156507	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1905	20:48:16.182463	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1907	20:48:16.223287	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1909	20:48:16.234632	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1911	20:48:16.260280	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1915	20:48:16.296642	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1927	20:48:17.296303	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1939	20:48:18.297331	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1951	20:48:19.297665	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1963	20:48:20.298046	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1975	20:48:21.299187	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1987	20:48:22.299218	192.168.136.128	192.168.136.129	TCP	3483	32866	634
1999	20:48:23.299843	192.168.136.128	192.168.136.129	TCP	3483	32866	634

632. The server sends a series of eight 'grfd' packets to player1 (192.168.136.129) starting at packet 1896 (20:48:16.079013) through packet 1911 (20:48:16.260280) with distinct contents, consistent with the "push left" animation. Packets 1444 (20:47:51.195152) through 1883 (20:48:15.295355) have identical 'grfd' payload, consistent with a repeated pre-sync screen:

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633. For example, packet 1871 (20:48:14.295306):

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```
> Frame 1871: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 71075, Ack: 4055, Len: 568
> Data (568 bytes)

0000  00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00  ..)Eo... )R...E
0010  02 6c 75 56 40 00 40 06 30 e3 c0 a8 88 80 c0 a8  ..luV@_@_...
0020  88 81 0d 9b 80 62 95 df 58 c5 76 f7 7e 1d 80 18  ....b...X.v~...
0030  05 a8 94 b1 00 00 01 01 08 0a 01 ee 3c 23 01 66  ....<#f
0040  88 d5 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24  ...6grfd·0.....$
0050  a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00  ..d@|·8...
0060  58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00  X....^·R·R~>...
0070  00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00  ..H`·x·? ...0·@·
0080  48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00  H·<~·R·R·r·2·
0090  00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00  ....~...
00a0  58 86 01 8e 01 1a f9 f2 00 e2 00 00 70 00 88 00  X.....p...
00b0  88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00  ....
00c0  20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00  ....
00d0  80 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00e0  80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00  ....p
00f0  88 00 88 00 88 00 70 00 00 00 00 00 00 00 00  ....p
0100  00 00 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00  ....H
0110  00 00 00 00 80 00 40 00 38 00 40 00 80 00 00 00  ....@ 8·@
0120  00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00  ....@
0130  70 00 88 00 88 00 88 00 50 00 00 00 00 00 00 00  p.....P
0140  00 00 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00  ....
0150  08 00 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00  ....
0160  80 00 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00  ....
0170  20 00 20 00 20 00 f8 00 00 00 00 00 48 00 00 00  ..H
0180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0190  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..d·8·
01c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  H.....
01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0260  00 00 00 00 00 00 00 70 00 70 00 70 00 70 01 fc  ....p·p·p·p·
0270  00 f8 00 70 00 20 00 00 00 00 00 00 00 00 00  ..p·
```

634. Has the same 'grfd' payload as packet 1883 (20:48:15.295355):

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```

> Frame 1883: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 71643, Ack: 4093, Len: 568
> Data (568 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00  ..)Eo... )R...E.
0010  02 6c 75 5a 40 00 40 06 30 df c0 a8 88 80 c0 a8  .luZ@.@. 0.....
0020  88 81 0d 9b 80 62 95 df 5a fd 76 f7 7e 43 80 18  ....b.. Z.v~C..
0030  05 a8 94 b1 00 00 01 01 08 0a 01 ee 40 0b 01 66  .......@..f
0040  8c bf 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24  ..6grfd .0.....$
0050  a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00  .De|.8.. ....
0060  58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00  X....^..R .R.~>..
0070  00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00  .H`.x.? ...0.@..
0080  48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00  H.<~..R .R.r.2..
0090  00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00  ....~.. .`. ....
00a0  58 86 01 8e 01 1a f9 f2 00 e2 00 00 70 00 88 00  X..... .p...
00b0  88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00  .... . .
00c0  20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00  .... . .
00d0  80 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
00e0  80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00  .... .p.
00f0  88 00 88 00 88 00 70 00 00 00 00 00 00 00 00 00  ....p.
0100  00 00 00 00 00 00 48 00 a8 00 a8 00 90 00 00 00  ....H.
0110  00 00 00 00 80 00 40 00 38 00 40 00 80 00 00 00  ....@. 8.@.
0120  00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00  ....@.
0130  70 00 88 00 88 00 88 00 50 00 00 00 00 00 00 00  p..... P.....
0140  00 00 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00  .... . .
0150  08 00 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00  .... . .
0160  80 00 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00  .... . .
0170  20 00 20 00 20 00 f8 00 00 00 00 48 00 00 00 00  . . . .H..
0180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0190  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
01a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
01b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
01c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
01d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
01e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .... . .
0260  00 00 00 00 00 00 00 70 00 70 00 70 00 01 fc  ....p .p.p.p.
0270  00 f8 00 70 00 20 00 00 00 00  ....p. ..

```

635. The payload for packets 1896 through 1911 differ, shifting off old content and shifting in new content.



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```

> Frame 1896: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 72211, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )·R...E·
0010 02 6c 75 60 40 00 40 06 30 d9 c0 a8 88 80 c0 a8 ·lu`@·@· 0·.....
0020 88 81 0d 9b 80 62 95 df 5d 35 76 f7 7e 7b 80 18 .....b· ]5v·~{·
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 1b 01 66 .....C·f
0040 91 42 02 36 67 72 66 64 02 30 00 00 00 7e 00 7e ·B·6grfd ·0·...~·
0050 00 20 f8 60 a0 60 a0 00 a0 00 58 86 01 8e 01 1a ·.·.·.·.·.·X·....
0060 f9 f2 00 e2 00 00 70 00 88 00 88 00 a8 00 b8 00 .....p· .....
0070 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 .....
0080 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 80 00 80 00 f8 00 .....
00a0 80 00 80 00 00 00 00 00 70 00 88 00 88 00 88 00 ..... p· .....
00b0 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 p· .....
00c0 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00 H· .....
00d0 40 00 38 00 40 00 80 00 00 00 00 00 f8 00 40 00 @·8·@·.· .....@·
00e0 20 00 10 00 f8 00 00 00 00 00 70 00 88 00 88 00 ..... p· .....
00f0 88 00 50 00 00 00 00 00 00 00 00 00 00 00 00 00 ..P· .....
0100 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00 .....
0110 00 00 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00 .....
0120 80 00 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 .....
0130 f8 00 00 00 00 00 48 00 00 00 00 00 00 00 00 00 .....H· .....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0220 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20 ·p·p·p·p· .....p·
0230 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 ..... ·$·D@|·8
0240 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e ..... ·X·...^
0250 f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78 ·R·R·~·> ···H·`x
0260 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e ·?·...0·@ ··H·<·~
0270 a8 52 90 52 00 72 00 32 00 00 ·R·R·r·2 ··

```

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```

> Frame 1898: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 72779, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )R...E
0010 02 6c 75 62 40 00 40 06 30 d7 c0 a8 88 80 c0 a8 ..lub@.@ 0.....
0020 88 81 0d 9b 80 62 95 df 5f 6d 76 f7 7e 7b 80 18 ....b..._mv~{..
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 35 01 66 .....C5.f
0040 91 47 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ..G6grfd .0.....
0050 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 .....
0060 00 00 70 00 88 00 88 00 88 00 70 00 00 00 00 00 ..p..... p.....
0070 00 00 00 00 00 00 00 00 00 00 48 00 a8 00 a8 00 .....H.....
0080 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00 .....@.8.@.
0090 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 .....@.....
00a0 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00 .....p... P...
00b0 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00 .....
00c0 08 00 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00 .....
00d0 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 .....
00e0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 .... .
00f0 48 00 00 00 00 00 00 00 00 00 00 00 00 00 00 H.....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01d0 00 00 00 00 00 00 00 00 00 00 00 70 00 70 00 70 ..... p.p.p
01e0 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f ..p...p ..
01f0 a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe ...$.D@| 8.....
0200 a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e ....X... ^R.R~
0210 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30 .>...H` x.?..0
0220 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72 .@..H.< ~R.R.r
0230 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60 .2...~ ~. .`
0240 a0 00 a0 00 58 86 01 8e 01 1a f9 f2 00 e2 00 00 ....X...
0250 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00 p.....
0260 20 00 20 00 20 00 f8 00 00 00 00 80 00 80 00 . . .
0270 f8 00 80 00 80 00 00 00 00 00 .....

```



## Contains Highly Confidential AEO and Source Code Materials

```

> Frame 1900: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 73347, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00  ..)Eo... )R...E
0010 02 6c 75 64 40 00 40 06 30 d5 c0 a8 88 80 c0 a8  .Lud@@. 0.....
0020 88 81 0d 9b 80 62 95 df 61 a5 76 f7 7e 7b 80 18  ....b..a-v~{..
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 4f 01 66  ....C0.f
0040 91 61 02 36 67 72 66 64 02 30 80 00 00 00 00 00  .a6grfd.0.....
0050 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00  .@. ... ..p
0060 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00  ....P. ....
0070 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00  ....
0080 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00  ....
0090 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00  ....
00a0 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00  . ....H....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0190 00 00 00 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8  ....p.p .p.p...
01a0 00 70 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44  .p. ....$.D
01b0 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00  @|.8....X
01c0 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00  ....^R.R ~>....
01d0 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00  H`x.?..0@..H
01e0 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 00 00  <~R.R.r.2....
01f0 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 86  ~~~. `.....X
0200 01 8e 01 1a f9 f2 00 e2 00 00 70 00 88 00 88 00  ....p.....
0210 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00  ....
0220 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00  ....
0230 00 00 00 00 00 00 00 00 00 00 00 00 80 00 00  ....
0240 80 00 f8 00 80 00 80 00 00 00 00 00 70 00 88 00  ....p...
0250 88 00 88 00 70 00 00 00 00 00 00 00 00 00 00 00  ....p.....
0260 00 00 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00  ....
0270 00 00 f8 00 40 00 20 00 10 00

```

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```

> Frame 1902: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 73915, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )R...E
0010 02 6c 75 66 40 00 40 06 30 d3 c0 a8 88 80 c0 a8 ..luf@.@ 0.....
0020 88 81 0d 9b 80 62 95 df 63 dd 76 f7 7e 7b 80 18 ....b..c.v~{..
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 69 01 66 .....Ci.f
0040 91 7b 02 36 67 72 66 64 02 30 80 00 f8 00 80 00 ..{.6grfd .0.....
0050 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 .....
0060 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 ....H...
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 70 .....p
0150 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00 ..p.p.p...p...
0160 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00 .....$ .D@|.8..
0170 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52 ..R~>...H`x.?
0180 a8 52 a8 7e 88 3e 00 00 00 48 60 a8 78 a8 3f ...0.@..H<~R
0190 a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52 ..R.r.2...~..
01a0 90 52 00 72 00 32 00 00 00 00 00 7e 00 7e 00 20 ..`..X.....
01b0 f8 60 a0 60 a0 00 a0 00 58 86 01 8e 01 1a f9 f2 ...p.....
01c0 00 e2 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00 .....
01d0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 .....
01e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 00 .....
01f0 00 00 00 00 00 00 00 00 80 00 80 00 f8 00 80 00 .....
0200 80 00 00 00 00 00 70 00 88 00 88 00 88 00 70 00 .....p.....p
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 .....
0220 08 00 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00 .....@
0230 20 00 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00 .....H.....
0240 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00 .....@.8.@
0250 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 .....@.....
0260 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00 ...p...P...
0270 00 00 00 00 00 00 00 00 00 00

```

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```

> Frame 1905: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 74483, Ack: 4167, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )R...E-
0010 02 6c 75 68 40 00 40 06 30 d1 c0 a8 88 80 c0 a8 ..luh@.@ 0.....
0020 88 81 0d 9b 80 62 95 df 66 15 76 f7 7e 8d 80 18 ....b... f.v~...
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 83 01 66 ....C..f
0040 91 9d 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ...6grfd 0.....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0100 00 00 00 00 00 00 00 00 00 70 00 70 00 70 00 70 .....p.p.p.p
0110 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f a0 7f .....p.....
0120 a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe ..$.D@|.8.....
0130 a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e ..X...^..R.R~>
0140 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 ...H`x ?...0.@
0150 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 ..H.<~..R.R.r.2
0160 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 .....~..`..
0170 a0 00 58 86 01 8e 01 1a f9 f2 00 e2 00 00 70 00 ..X.....p.
0180 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 .....
0190 20 00 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 .....
01a0 80 00 80 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 .....
01c0 70 00 88 00 88 00 88 00 70 00 00 00 00 00 00 00 p.....p.....
01d0 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 08 00 .....
01e0 f0 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 .....@.....
01f0 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00 ...H...@.....
0200 00 00 80 00 40 00 38 00 40 00 80 00 00 00 00 00 ...@.8. @.....
0210 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00 ..@... ..p.
0220 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00 .....P.....
0230 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00 .....
0240 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00 .....
0250 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00 .....
0260 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00 .....H.....
0270 00 00 00 00 00 00 00 00 00 00

```



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```

> Frame 1907: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 75051, Ack: 4167, Len: 568
> Data (568 bytes)

0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )R...E
0010 02 6c 75 6a 40 00 40 06 30 cf c0 a8 88 80 c0 a8 .luj@. 0.....
0020 88 81 0d 9b 80 62 95 df 68 4d 76 f7 7e 8d 80 18 .....b...hMv~...
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 ac 01 66 .....C..f
0040 91 d7 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ..6grfd 0.....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70 ...p.p.p.p.....p
00d0 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c . ....$.D@|
00e0 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c .8.....X...
00f0 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60 .^R.R~>...H`
0100 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c .x.7...0 @..H.<
0110 a8 7e a8 52 90 52 00 72 00 32 00 00 00 00 00 7e .~R.R.r.2....~
0120 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 86 01 8e .~. .` . .X...
0130 01 1a f9 f2 00 e2 00 00 70 00 88 00 88 00 a8 00 .....p.....
0140 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 .....
0150 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 .....
0160 00 00 00 00 00 00 00 00 00 00 00 00 80 00 80 00 .....
0170 f8 00 80 00 80 00 00 00 00 00 70 00 88 00 88 00 .....p.....
0180 88 00 70 00 00 00 00 00 00 00 00 00 00 00 00 00 ..p.....
0190 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00 00 00 .....
01a0 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 48 00 ..@. ....H.
01b0 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00 40 00 .....@.
01c0 38 00 40 00 80 00 00 00 00 00 f8 00 40 00 20 00 8.@.....@.
01d0 10 00 f8 00 00 00 00 00 70 00 88 00 88 00 88 00 .....p.....
01e0 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 P.....
01f0 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00 00 00 .....
0200 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 .....
0210 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 .....
0220 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 00 ....H...
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0270 00 00 00 00 00 00 00 00 00 00

```

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```

> Frame 1909: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 75619, Ack: 4167, Len: 568
> Data (568 bytes)

0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )R...E.
0010 02 6c 75 6c 40 00 40 06 30 cd c0 a8 88 80 c0 a8 .lul@.@ 0.....
0020 88 81 0d 9b 80 62 95 df 6a 85 76 f7 7e 8d 80 18 ....b.. j.v~...
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 b7 01 66 .....C..f
0040 91 d8 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ..6grfd .0.....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 70 00 70 .....p.p
0080 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00 00 .p.p... .p....
0090 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00 ....$.D @|.8....
00a0 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52 ....X... ^R.R
00b0 a8 7e 88 3e 00 00 00 48 60 a8 78 a8 3f a8 0c ..>... H`x.?..
00c0 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52 .0.@.H. <~R.R
00d0 00 72 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60 .r.2.... ~~~.
00e0 a0 60 a0 00 a0 00 58 86 01 8e 01 1a f9 f2 00 e2 ....X.....
00f0 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00 ..p.....
0100 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 80 00 . . .
0110 80 00 f8 00 80 00 80 00 00 00 00 00 00 00 00 00 .....
0120 00 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 .....
0130 00 00 00 00 70 00 88 00 88 00 88 00 70 00 00 00 ....p... .p...
0140 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00 .....
0150 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00 20 00 .....@.
0160 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00 a8 00 .....H.....
0170 90 00 00 00 00 00 80 00 40 00 38 00 40 00 80 00 .....@.8@...
0180 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 .....@.
0190 00 00 70 00 88 00 88 00 88 00 50 00 00 00 00 00 ..p..... .P.....
01a0 00 00 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 .....
01b0 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00 00 00 .....
01c0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 .....
01d0 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 48 00 . . . .H.
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0270 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```



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```

> Frame 1911: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 76187, Ack: 4167, Len: 568
> Data (568 bytes)

0000  00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00  ..)Eo... )R...E
0010  02 6c 75 6e 40 00 40 06 30 cb c0 a8 88 80 c0 a8  .lun@. 0.....
0020  88 81 0d 9b 80 62 95 df 6c bd 76 f7 7e 8d 80 18  ....b.. l.v~...
0030  05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 d1 01 66  ....C..f
0040  91 e3 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24  ..6grfd .0....$
0050  a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00  .D@|.8.. ....
0060  58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00  X....^..R .R.~>..
0070  00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00  ..H`.x.? ...0.@..
0080  48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00  H.<~..R .R.r.2..
0090  00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00  ..~.. ..'.
00a0  58 86 01 8e 01 1a f9 f2 00 e2 00 00 70 00 88 00  X..... ..p...
00b0  88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00  ....
00c0  20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00  ....
00d0  80 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00e0  80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00  ....p.
00f0  88 00 88 00 88 00 70 00 00 00 00 00 00 00 00  ....p. ....
0100  00 00 00 00 00 00 00 f0 08 00 08 00 08 00 f0 00  ....
0110  00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00  ....@. ....
0120  00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00  ..H.....
0130  80 00 40 00 38 00 40 00 80 00 00 00 00 00 f8 00  .@.8.@. ....
0140  40 00 20 00 10 00 f8 00 00 00 00 00 70 00 88 00  @. ....p...
0150  88 00 88 00 50 00 00 00 00 00 00 00 00 00 00  ....P...
0160  00 00 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00  ....
0170  f0 00 00 00 00 00 f8 00 00 00 00 80 00 80 00  ....
0180  f8 00 80 00 80 00 00 00 00 00 f8 00 20 00 20 00  ....
0190  20 00 f8 00 00 00 00 00 48 00 00 00 00 00 00 00  ....H.....
01a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0260  00 00 00 00 00 00 70 00 70 00 70 00 70 01 fc  ....p .p.p.p.
0270  00 f8 00 70 00 20 00 00 00 00  ....p. .

```

636. Packets 1915 through 2086 (the last 'grfd' packet in the trace) contain the same 'grfd' payload as packet 1911. For example, packet 1915:

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```
> Frame 1915: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 76755, Ack: 4167, Len: 568
> Data (568 bytes)

0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00 ..)Eo... )R...E.
0010 02 6c 75 70 40 00 40 06 30 c9 c0 a8 88 80 c0 a8 ..lup@.@. 0.....
0020 88 81 0d 9b 80 62 95 df 6e f5 76 f7 7e 8d 80 18 .....b...n.v~...
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 f5 01 66 .....n...C..f
0040 91 fd 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24 ...6grfd..0....$
0050 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 ..D@|.8.. ....
0060 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 X...^..R..R~>..
0070 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 ..H`.x.? ...0.@..
0080 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 H.<~..R..R.r.2..
0090 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 ..~..~..`..`....
00a0 58 86 01 8e 01 1a f9 f2 00 e2 00 00 70 00 88 00 X.....p...
00b0 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 ..... ..
00c0 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 ..... ..
00d0 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
00e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00 .....p.
00f0 88 00 88 00 88 00 70 00 00 00 00 00 00 00 00 .....p. ....
0100 00 00 00 00 00 00 f0 00 08 00 08 00 08 00 f0 00 ..... ..
0110 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 .....@. ....
0120 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00 ..H.....
0130 80 00 40 00 38 00 40 00 80 00 00 00 00 00 f8 00 ..@.8.@. ....
0140 40 00 20 00 10 00 f8 00 00 00 00 00 70 00 88 00 @. ....p...
0150 88 00 88 00 50 00 00 00 00 00 00 00 00 00 00 ....P... ..
0160 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00 ..... ..
0170 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00 80 00 ..... ..
0180 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00 20 00 ..... ..
0190 20 00 f8 00 00 00 00 00 48 00 00 00 00 00 00 00 .....H.....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... ..
0260 00 00 00 00 00 00 00 70 00 70 00 70 00 01 fc .....p.p.p.p..
0270 00 f8 00 70 00 20 00 00 00 00 .....p.. ..
```

637. The slimserver1 log entries are consistent with the network trace. Filtering the slimserver1 log shows player-to-server IR codes and server-to-player SlimProto frames:

```
grep -P 'op IR |sending squeezebox frame' slimserver-01.log
```

638. The filtered results show a last IR packet cluster at 20:48:16.0756 and 20:48:16.1657, representing the "right arrow" that initiates the sync. There are eight 'grfd' messages following the 20:48:16.0756 IR packet, with the eighth 'grfd' packet at 20:48:16.2601.



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639. The timestamp for that eighth 'grfd' packet (20:48:16.2601) is consistent with the network timestamp for packet 1911 (20:48:16.260280), modulo skew between the application logging and network timestamps.

```

2022-06-21 20:48:15.2952 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:15.3068 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.0756 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.0789 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1043 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1302 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1564 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1657 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.1823 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2083 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2344 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2601 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2872 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2965 sending squeezebox frame: grfd, length: 562

```

640. Consequently, packet 1911 (20:48:16.260280) represents the 'grfd' message sent from slimserver1 to player1 with the post-sync screen:



641. We now define the second sync group on slimserver2. To set up the login and network trace, we stop slimserver2, clear the slimserver2 log file, and then start slimserver2. A new log file will be started in /tmp/slimserver.log.

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```
/etc/rc.d/init.d/slimserver stop  
rm /tmp/slimserver.log  
/etc/rc.d/init.d/slimserver start
```

642. In Home / Server Settings / Debugging, turn on debugging settings related to SlimProto. As a result, information about SlimProto protocol operation is logged to the log file (/tmp/slimserver.log).

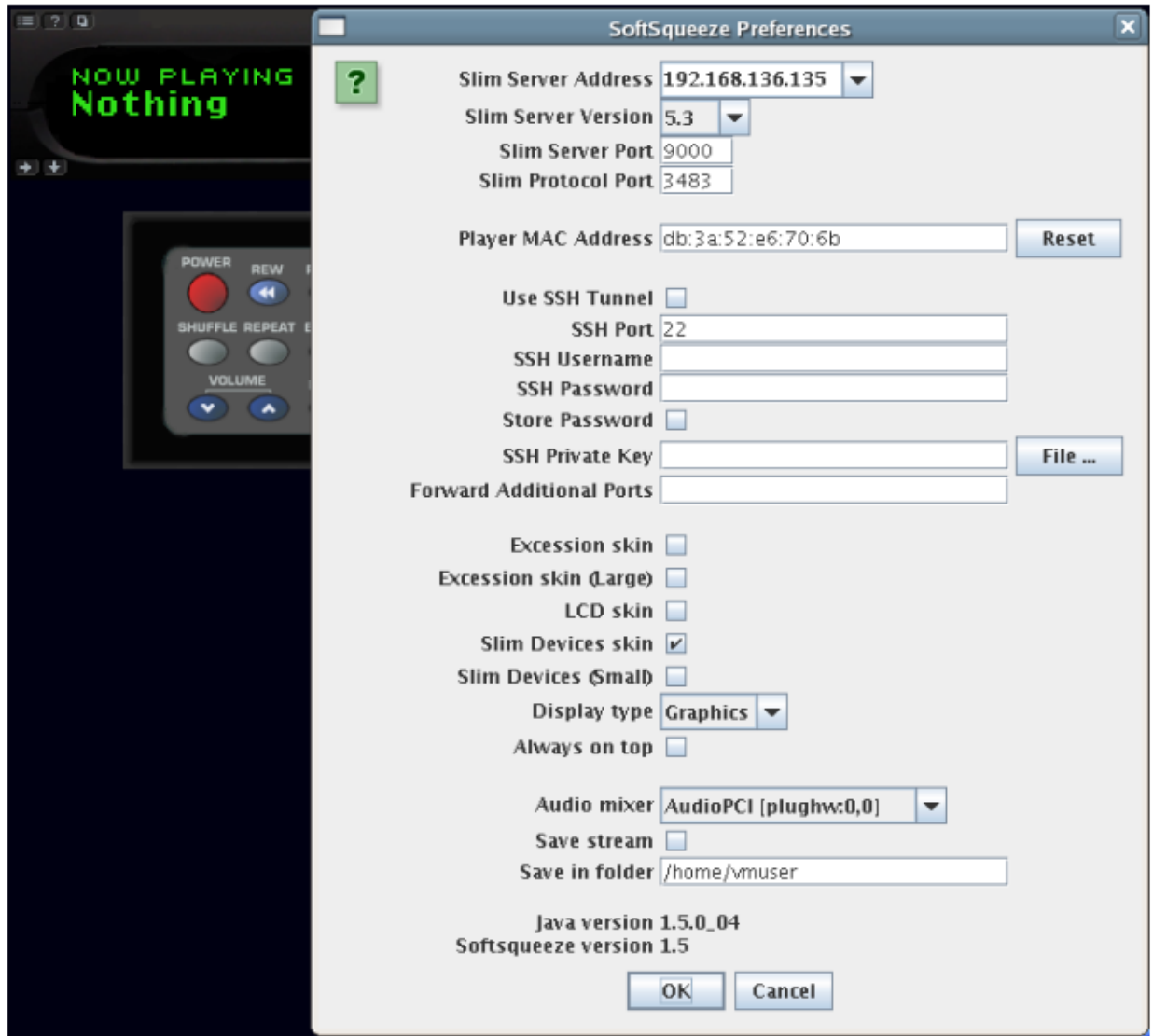
<input type="checkbox"/> d_server	Change
<input checked="" type="checkbox"/> d_slimproto	Change
<input checked="" type="checkbox"/> d_slimproto_v	Change
<input type="checkbox"/> d_source	Change

643. Start a network trace.

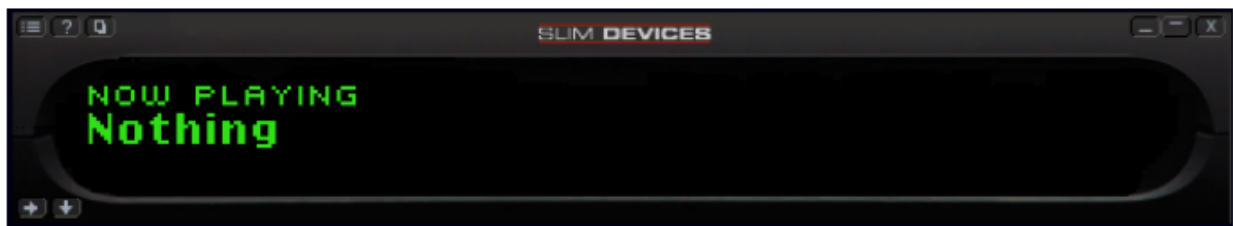
```
tcpdump -i eth0 -s 0 -w slimserver2-01.pcap
```

644. We then switch to slimserver2. On each player, press the settings icon at the top-left of the SoftSqueeze player to bring up the SoftSqueeze settings dialog. Configure the server to be slimserver2 (192.168.136.135). For example (player1):

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645. Do the same for player2 and player3. There is no need to power on player2 and player3 first. The SoftSqueeze settings can be configured without powering the players on. However, the players automatically power on when connected to slimserver2.



646. The Web UI for slimserver2 shows the players with IP addresses but no names.

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**SETTINGS**

- Server Settings
- Player Settings for 192.168.136.129
- Player Settings for 192.168.136.130
- Player Settings for 192.168.136.131

647. Configure the player names for player1, player2, and player3 as with slimserver1.

For example:

**Player Name**

You can give this player a name that will be used to identify the player on these web pages.

Player name:

648. Use the Web UI to power off all players. At this point, all players are persisted to slimserver1's preferences file with the defined names (player1, player2, and player3), power synchronization "off" (0), no sync groups, and power state "off" (0).

```
[vmuser@slimserver2 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 0
db:3a:52:e6:70:6b-syncPower = 0
```

649. We can now define the second synchrony group. Press the power button to power player1 back up and allow for interaction. The player briefly shows the welcome screen and then transitions to the home screen.

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650. Press up arrow to switch to the "Settings" menu item.



651. Press right arrow to select "Settings" and show the first Settings menu item ("Alarm Clock," setting 1 of 13).

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652. Press up arrow to switch to the "Synchronize" menu item (setting 13 of 13).



653. Press right arrow to select "Synchronize" and show a first synchronization choice (player3).

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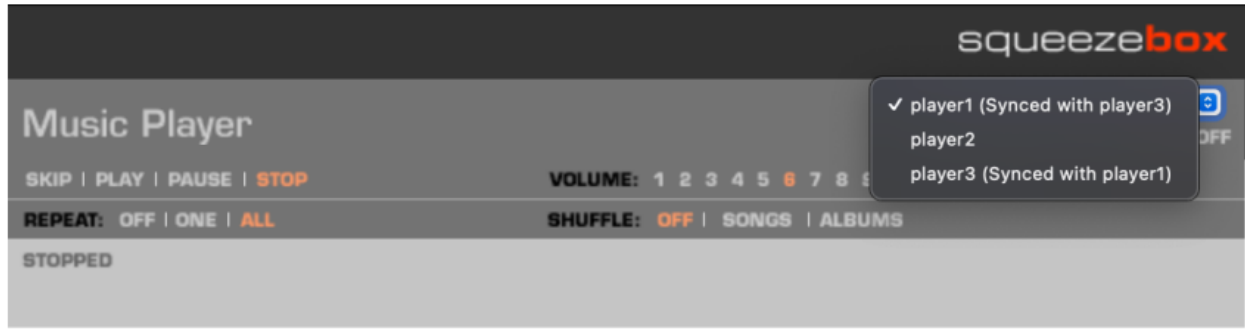
654. Press right arrow to select synchronization with player3. The screen changes to show that player3 is synced, with the menu choice now representing a choice to unsync.



655. The Web UI shows player1 and player3 synced. (Note: this screen shows player1 and player3 as synced even though player3 is off. This may be because synchronization was configured while player3 is off.)



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656. slimserver2's preferences file shows player1 and player3 defined in the same sync group (361890235). player1 is powered on. player2 and player3 are powered off.

```
[vmuser@slimserver2 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 361890235
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncgroupid = 361890235
```

657. We can now discuss the network messages for defining the second sync group. As shown above, synchronizing player1 with player3 involves a series of remote control inputs and player1 screens. Both the remote control inputs and resulting screens involve SlimProto network messages between slimserver1 and player1.

- player1 sends "IR " SlimProto messages to slimserver1 for each IR events, such as button presses.
- slimserver1 sends "grfd" SlimProto messages to to player1 to display graphical screens

658. We first identify the IR SlimProto messages, which send IR codes from the player to the SlimServer. From the identified IR messages, the last "right arrow" IR packet represents the "right arrow" button press that initiates sync for player1 and player3. The "right arrow" IR SlimProto packets are then identified using a WireShark display filter that selects for:

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destination port 3483 — from player to SlimServer  
 data that begins with "IR " — the IR type  
 data that has 0x7689d02f in the four bytes beginning at offset 14

659. Which is expressed as:

```
tcp.dstport == 3483 && data.data[0:4] == "IR " && data.data[14:4] == 76:89:d0:2f
```

660. There are six matching network packets, clustered in groups of two (13875/13889, 14486/14496, and 14872 /14882). Within a cluster, the packets occur very close in time (e.g., within 0.1 seconds for 13875/13889). Because the clustered IR packets are very close in time, an IR cluster is consistent with a button repeat sequence as handled by the SlimServer IR code.

Slim::Hardware::IR::processIR(), Slim/Hardware/IR.pm (v5.3.1), 334–393 at 365–376

661. The three clusters represent the three "right arrow" presses performed in the synchronization flow described above. The first "right arrow" selects the "Settings" menu item, the second "right arrow" selects the "Synchronize" menu item, and the third "right arrow" selects the sync group to join. The last IR packet cluster (14872 at 01:13:37.624794; 14882 at 01:31:37.717340) thereby represents the "arrow\_right" IR code that initiates the sync

tcp.dstport == 3483 && data.data[0:4] == "IR " && data.data[14:4] == 76:89:d0:2f							
No.	Time	Source	Destination	Protocol	Source Port	Destination Port	Length
13875	01:30:42.401868	192.168.136.129	192.168.136.135	TCP	32886	3483	84
13889	01:30:42.504236	192.168.136.129	192.168.136.135	TCP	32886	3483	84
14486	01:31:18.165704	192.168.136.129	192.168.136.135	TCP	32886	3483	84
14496	01:31:18.258447	192.168.136.129	192.168.136.135	TCP	32886	3483	84
14872	01:31:37.624794	192.168.136.129	192.168.136.135	TCP	32886	3483	84
14882	01:31:37.717340	192.168.136.129	192.168.136.135	TCP	32886	3483	84

662. The slimserver2 log file is consistent with the network trace (modulo a slight time skew between the network stack timestamp and the application logging timestamp).

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```
[vmuser@slimserver2 example]$ grep 'op IR ' slimserver2-01.log
2022-06-22 01:17:14.0381 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:17:33.2673 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c24f4c)
2022-06-22 01:17:49.8490 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c14860)
2022-06-22 01:30:05.3874 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:05.4790 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:25.9373 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:26.0287 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:42.4033 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:42.5056 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:59.6879 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:59.7800 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:18.1667 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:18.2595 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:37.6259 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:37.7183 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOB(0x9c33b68)
```

663. After packet 14872 (01:13:37.624794), SlimServer responds with a series of eight 'grfd' command packets to the player animating the new screen pushing the old screen off to the left. See, e.g.: Slim::Player::SqueezeboxG::pushLeft(), Slim/Player/SqueezeboxG.pm (v5.3.1), 401–414 at 413; Slim::Player::SqueezeboxG::pushUpdate(), Slim/Player/SqueezeboxG.pm (v5.3.1), 447–464 at 459; Slim::Player::SqueezeboxG::drawFrameBuf(), Slim/Player/SqueezeboxG.pm (v5.3.1), 368–382 at 380.

664. Each such packet begins with a two-byte length field and a four-byte command field. The 'grfd' are identified in the network trace using a WireShark display filter that selects for: source port 3483 — from SlimServer to player; TCP length > 0 — to filter out pure acknowledgement packets; command code 'grfd'; destination 192.168.136.129 (player1).

```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129
```

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tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129							
No.	Time	Source	Destination	Protocol	Source Port	Destination Port	Length
14796	01:31:31.544339	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14808	01:31:32.545144	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14820	01:31:33.545706	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14832	01:31:34.546145	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14844	01:31:35.546841	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14856	01:31:36.547260	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14868	01:31:37.547797	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14874	01:31:37.628768	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14876	01:31:37.654575	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14878	01:31:37.680275	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14880	01:31:37.706544	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14883	01:31:37.732211	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14885	01:31:37.772730	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14887	01:31:37.784182	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14893	01:31:37.810231	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14899	01:31:38.548328	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14911	01:31:39.548866	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14923	01:31:40.549496	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14935	01:31:41.549951	192.168.136.135	192.168.136.129	TCP	3483	32886	634
14947	01:31:42.550553	192.168.136.135	192.168.136.129	TCP	3483	32886	634

665. The server sends a series of eight 'grfd' packets to player1 (192.168.136.129) starting at packet 14874 (01:31:37.628768) through packet 14893 (01:31:37.810231) with distinct contents, consistent with the "push left" animation. Packets 14505 (01:31:18.349026) through 14868 (01:31:37.547797) have identical 'grfd' payload, consistent with a repeated pre-sync screen:



666. For example, packet 14856 (01:31:36.547260):

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```

> Frame 14856: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 504607, Ack: 33049, Len: 568
> Data (568 bytes)

0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E
0010 02 6c f6 1d 40 00 40 06 b0 14 c0 a8 88 87 c0 a8  .l...@.@...
0020 88 81 0d 9b 80 76 91 60 f9 da 7c 0a 51 9e 80 18  ...v...|.Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e3 4c 02 6a  ...L.j
0040 11 ba 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24  ...6grfd .0....$
0050 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00  .D@|.8...
0060 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00  X...^~R .R~>..
0070 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00  .H`~x? ...0.@..
0080 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00  H~<~R .R.r.2..
0090 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00  ~~~~ ..
00a0 58 84 01 82 01 22 f9 fe 00 dc 00 00 70 00 88 00  X...."....p...
00b0 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00  ..p...
00c0 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00  .....
00d0 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00  .....p
00f0 88 00 88 00 88 00 70 00 00 00 00 00 00 00 00 00  .....p
0100 00 00 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00  .....H
0110 00 00 00 00 80 00 40 00 38 00 40 00 80 00 00 00  .....@ 8@.....
0120 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00  .....@
0130 70 00 88 00 88 00 88 00 50 00 00 00 00 00 00 00  p.....P.....
0140 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00  .....
0150 08 00 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00  .....
0160 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00  .....
0170 20 00 20 00 20 00 f8 00 00 00 00 00 48 00 00 00  . . . . .H...
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0260 00 00 00 00 00 00 00 70 00 70 00 70 00 70 01 fc  ....p .p.p.p..
0270 00 f8 00 70 00 20 00 00 00  ....p...

```

667. has the same 'grfd' payload as packet 14868 (01:31:37.547260):



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```

> Frame 14868: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 505175, Ack: 33087, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00 ..)Eo... );...E
0010 02 6c f6 21 40 00 40 06 b0 10 c0 a8 88 87 c0 a8 .l!@. @. ....
0020 88 81 0d 9b 80 76 91 60 fc 12 7c 0a 51 c4 80 18 .....v` .|.Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 35 02 6a .....5.j
0040 15 a4 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24 ..6grfd .0....$
0050 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 .D@|.8. ....
0060 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 X....^R .R.~>..
0070 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 .H`.x.? ...0.@..
0080 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 H.<~R .R.r.2..
0090 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 .~.~. .`..
00a0 58 84 01 82 01 22 f9 fe 00 dc 00 00 70 00 88 00 X...." . .p...
00b0 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 .....
00c0 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 .....
00d0 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00 .....p.
00f0 88 00 88 00 88 00 70 00 00 00 00 00 00 00 00 .....p.
0100 00 00 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00 .....H.
0110 00 00 00 00 80 00 40 00 38 00 40 00 80 00 00 00 .....@. 8.@....
0120 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 .....@.
0130 70 00 88 00 88 00 88 00 50 00 00 00 00 00 00 00 p.....P.....
0140 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 .....
0150 08 00 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 .....
0160 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 .....
0170 20 00 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 . . . . .H...
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0260 00 00 00 00 00 00 00 70 00 70 00 70 00 01 fc .....p .p.p.p..
0270 00 f8 00 70 00 20 00 00 00 00 .....p.

```

668. The payload for packets 14874 through 14893, shifting off old content and shifting in new content:

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```

> Frame 14874: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 505743, Ack: 33105, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E-
0010 02 6c f6 25 40 00 40 06 b0 0c c0 a8 88 87 c0 a8  .l.%@.@. ....
0020 88 81 0d 9b 80 76 91 60 fe 4a 7c 0a 51 d6 80 18  ....v` .J|~Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 86 02 6a  ....j
0040 18 45 02 36 67 72 66 64 02 30 00 00 00 7e 00 7e  .E~6grfd ~0....~
0050 00 20 f8 60 a0 60 a0 00 a0 00 58 84 01 82 01 22  ....X...."
0060 f9 fe 00 dc 00 00 70 00 88 00 88 00 a8 00 b8 00  ....p.....
0070 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00  .... .
0080 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00  ....
0090 00 00 00 00 00 00 00 00 00 00 80 00 80 00 f8 00  ....
00a0 80 00 80 00 00 00 00 00 70 00 88 00 88 00 88 00  .... p.....
00b0 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  p.....
00c0 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00  H.....
00d0 40 00 38 00 40 00 80 00 00 00 00 00 f8 00 40 00  @~8~@... ..@~
00e0 20 00 10 00 f8 00 00 00 00 00 70 00 88 00 88 00  .... p.....
00f0 88 00 50 00 00 00 00 00 00 00 00 00 00 00 00 00  ..P.....
0100 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00  ....
0110 00 00 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00  ....
0120 80 00 80 00 00 00 00 00 f8 00 20 00 20 00 20 00  ....
0130 f8 00 00 00 00 00 48 00 00 00 00 00 00 00 00 00  ....H~
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0220 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20  .p.p.p.p .....p~
0230 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38  .... $~D@|~8
0240 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e  .... X....^
0250 f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78  .R~R~> ....H`~x
0260 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e  .?~0~@ ..H~<~
0270 a8 52 90 52 00 72 00 32 00 00  .R~R~r~2 ..

```



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```

> Frame 14876: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 506311, Ack: 33105, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00 ..)Eo...);...E.
0010 02 6c f6 27 40 00 40 06 b0 0a c0 a8 88 87 c0 a8 .l.'@.@.....
0020 88 81 0d 9b 80 76 91 61 00 82 7c 0a 51 d6 80 18 ....v.a...|Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 a0 02 6a .....j
0040 18 49 02 36 67 72 66 64 02 30 00 00 00 00 00 00 .I.6grfd.0.....
0050 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 .....
0060 00 00 70 00 88 00 88 00 88 00 70 00 00 00 00 00 ..p.....p.....
0070 00 00 00 00 00 00 00 00 00 00 48 00 a8 00 a8 00 .....H.....
0080 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00 .....@.8.@.
0090 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 .....@.....
00a0 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00 ....p.....P...
00b0 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00 .....
00c0 08 00 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00 .....
00d0 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 .....
00e0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 .....
00f0 48 00 00 00 00 00 00 00 00 00 00 00 00 00 00 H.....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01d0 00 00 00 00 00 00 00 00 00 00 00 70 00 70 00 70 .....p.p.p
01e0 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f .p.....p.....
01f0 a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe ...$.D@|.8.....
0200 a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e ...X...^R.R~
0210 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30 >...H`x?...0
0220 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72 @.H.<~R.R.r
0230 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60 .2.....~..`
0240 a0 00 a0 00 58 84 01 82 01 22 f9 fe 00 dc 00 00 ...X...".
0250 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00 p.....
0260 20 00 20 00 20 00 f8 00 00 00 00 80 00 80 00 .
0270 f8 00 80 00 80 00 00 00 00 00

```

Contains Highly Confidential AEO and Source Code Materials

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> Frame 14878: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 506879, Ack: 33105, Len: 568
> Data (568 bytes)

0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo...);...E.
0010  02 6c f6 29 40 00 40 06 b0 08 c0 a8 88 87 c0 a8  .l.)@.@.....
0020  88 81 0d 9b 80 76 91 61 02 ba 7c 0a 51 d6 80 18  ....v.a...|Q...
0030  05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 ba 02 6a  .........j
0040  18 63 02 36 67 72 66 64 02 30 80 00 00 00 00 00  .c.6grfd.0.....
0050  f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00  .@. ... ..p.
0060  88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00  ....P. ....
0070  00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00  ....
0080  08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00  ....
0090  80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00  ....
00a0  20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00  . ....H....
00b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0110  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0120  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0130  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0140  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0150  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0160  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0170  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0190  00 00 00 00 00 00 70 00 70 00 70 01 fc 00 f8  ....p.p.p.p...
01a0  00 70 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44  .p. ....$.D
01b0  40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00  @|.8....X.
01c0  00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00  ...^R.R.~>...
01d0  48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00  H`x.?..0@.H.
01e0  a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 00 00  <~R.R.r2...
01f0  00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 84  ~~~.``...X.
0200  01 82 01 22 f9 fe 00 dc 00 00 70 00 88 00 88 00  ...". ...p...
0210  a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00  ....
0220  f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00  ....
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 80 00  ....
0240  80 00 f8 00 80 00 80 00 00 00 00 00 70 00 88 00  ....p...
0250  88 00 88 00 70 00 00 00 00 00 00 00 00 00 00 00  ....p...
0260  00 00 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00  ....
0270  00 00 f8 00 40 00 20 00 10 00  ....@. ...

```

Contains Highly Confidential AEO and Source Code Materials

```

> Frame 14880: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 507447, Ack: 33105, Len: 568
> Data (568 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo...);...E.
0010  02 6c f6 2b 40 00 40 06 b0 06 c0 a8 88 87 c0 a8  .l.+@.@.....
0020  88 81 0d 9b 80 76 91 61 04 f2 7c 0a 51 d6 80 18  ....v.a...|Q...
0030  05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 d4 02 6a  .........j
0040  18 7d 02 36 67 72 66 64 02 30 80 00 f8 00 80 00  .}.6grfd.0.....
0050  80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00  ....
0060  00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 00  ....H...
0070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0110  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0120  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0130  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0140  00 00 00 00 00 00 00 00 00 00 00 00 00 00 70  ....p
0150  00 70 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00  .p.p.p...p...
0160  00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00  ....$D@|.8..
0170  f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52  ....X....^R
0180  a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78 a8 3f  .R~>...H`x.?
0190  a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52  ...0.@.H<~R
01a0  90 52 00 72 00 32 00 00 00 00 00 00 7e 00 7e 00  .R.r.2...~.
01b0  f8 60 a0 60 a0 00 a0 00 58 84 01 82 01 22 f9 fe  .`^....X...."
01c0  00 dc 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00  ....p...
01d0  00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00  ....
01e0  80 00 80 00 f8 00 80 00 80 00 00 00 00 00 00 00  ....
01f0  00 00 00 00 00 00 00 00 80 00 80 00 f8 00 80 00  ....
0200  80 00 00 00 00 00 70 00 88 00 88 00 88 00 70 00  ....p.....p
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 f0 00  ....
0220  08 00 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00  ....@
0230  20 00 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00  ....H.....
0240  a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00  ....@8.@
0250  80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00  ....@.....
0260  00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00  ....p.....P
0270  00 00 00 00 00 00 00 00 00 00

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Contains Highly Confidential AEO and Source Code Materials

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> Frame 14883: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 508015, Ack: 33123, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00 ..)Eo...);...E
0010 02 6c f6 2d 40 00 40 06 b0 04 c0 a8 88 87 c0 a8 ..l-@.@. ....
0020 88 81 0d 9b 80 76 91 61 07 2a 7c 0a 51 e8 80 18 .....v.a*|.Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 ee 02 6a .....j
0040 18 a1 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ...6grfd.0.....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0100 00 00 00 00 00 00 00 00 70 00 70 00 70 00 70 .....p.p.p.p
0110 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f a0 7f .....p
0120 a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe ..$.D@|.8 .....
0130 a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e ..X....^..R.R.~>
0140 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 ....H`x.?...0.@
0150 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 ..H.<~..R.R.r.2
0160 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 .....~..`..
0170 a0 00 58 84 01 82 01 22 f9 fe 00 dc 00 00 70 00 ..X....".....p
0180 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 .....
0190 20 00 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 .....
01a0 80 00 80 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 .....
01c0 70 00 88 00 88 00 88 00 70 00 00 00 00 00 00 p.....p.....
01d0 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 08 00 .....
01e0 f0 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 .....@.....
01f0 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00 ....H.....
0200 00 00 80 00 40 00 38 00 40 00 80 00 00 00 00 00 ....@.8. @.....
0210 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00 ..@. ...p
0220 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 .....P.....
0230 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00 .....
0240 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00 .....
0250 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00 .....
0260 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00 .....H.....
0270 00 00 00 00 00 00 00 00 00 00

```

## Contains Highly Confidential AEO and Source Code Materials

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> Frame 14885: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 508583, Ack: 33123, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E.
0010 02 6c f6 2f 40 00 40 06 b0 02 c0 a8 88 87 c0 a8  .l./@. @. ....
0020 88 81 0d 9b 80 76 91 61 09 62 7c 0a 51 e8 80 18  ....v.a .b|.Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e8 16 02 6a  .......j
0040 18 d9 02 36 67 72 66 64 02 30 00 00 00 00 00 00  ..6grfd .0.....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00c0 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70  ...p.p.p .p....p
00d0 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c  .... $.D@|
00e0 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c  .8..... .X...
00f0 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60  .^R.R~ .>....H`
0100 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c  .x.?...0 .@..H..<
0110 a8 7e a8 52 90 52 00 72 00 32 00 00 00 00 00 7e  ~R.R.r .2.....~
0120 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 84 01 82  ~. .` .X...
0130 01 22 f9 fe 00 dc 00 00 70 00 88 00 88 00 a8 00  ."..... p.....
0140 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00  ....
0150 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00  ....
0160 00 00 00 00 00 00 00 00 00 00 00 00 80 00 80 00  ....
0170 f8 00 80 00 80 00 00 00 00 00 70 00 88 00 88 00  ....
0180 88 00 70 00 00 00 00 00 00 00 00 00 00 00 00  ..p.....
0190 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00 00 00  ....
01a0 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 48 00  ..@. . .H.
01b0 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00 40 00  ....
01c0 38 00 40 00 80 00 00 00 00 00 f8 00 40 00 20 00  8.@.....@.
01d0 10 00 f8 00 00 00 00 00 70 00 88 00 88 00 88 00  ....
01e0 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00  P.....
01f0 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00 00 00  ....
0200 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00  ....
0210 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00  ....
0220 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00  ....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0270 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....

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Contains Highly Confidential AEO and Source Code Materials

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> Frame 14887: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 509151, Ack: 33123, Len: 568
> Data (568 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E.
0010  02 6c f6 31 40 00 40 06 b0 00 c0 a8 88 87 c0 a8  .l.1@.@. ....
0020  88 81 0d 9b 80 76 91 61 0b 9a 7c 0a 51 e8 80 18  ....v.a ..|Q...
0030  05 a8 94 b8 00 00 01 01 08 0a 02 ca e8 22 02 6a  .......".j
0040  18 d9 02 36 67 72 66 64 02 30 00 00 00 00 00 00  ..6grfd .0.....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0070  00 00 00 00 00 00 00 00 00 00 00 00 70 00 70  ....p.p
0080  00 70 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00  .p.p....p....
0090  f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00  ....$.D @|.8....
00a0  a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52  ....X. ...^..R
00b0  a8 7e 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c  ~>....H`x.?..
00c0  90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52  .0.@..H. <~..R
00d0  00 72 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60  .r.2....~..`
00e0  a0 60 a0 00 a0 00 58 84 01 82 01 22 f9 fe 00 dc  .X. ...."....
00f0  00 00 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00  ..p....
0100  f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 80 00  . . . .
0110  80 00 f8 00 80 00 80 00 00 00 00 00 00 00 00  ....
0120  00 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00  ....
0130  00 00 00 00 70 00 88 00 88 00 88 00 70 00 00 00  ....p....p...
0140  00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00  ....
0150  08 00 08 00 f0 00 00 00 00 00 f8 00 40 00 20 00  ....@.
0160  10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00 a8 00  ....H.
0170  90 00 00 00 00 00 80 00 40 00 38 00 40 00 80 00  ....@.8.@...
0180  00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00  ....@.
0190  00 00 70 00 88 00 88 00 88 00 50 00 00 00 00 00  ..p....P....
01a0  00 00 00 00 00 00 00 00 00 00 f0 00 08 00 08 00  ....
01b0  f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00 00 00  ....
01c0  00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00  ....
01d0  f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 48 00  . . . .H.
01e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0270  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..

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Contains Highly Confidential AEO and Source Code Materials

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> Frame 14893: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 509719, Ack: 33123, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00 ..)Eo...);...E.
0010 02 6c f6 33 40 00 40 06 af fe c0 a8 88 87 c0 a8 .l.3@.@.....
0020 88 81 0d 9b 80 76 91 61 0d d2 7c 0a 51 e8 80 18 ....v.a...|Q...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e8 3c 02 6a ....<.j
0040 18 e5 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24 ...6grfd..0....$
0050 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 .De|.8.....
0060 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 X....^..R..R~>..
0070 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 ..H`.x.?...0.@..
0080 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 H.<~..R..R.r.2..
0090 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 ....~..`..`..2..
00a0 58 84 01 82 01 22 f9 fe 00 dc 00 00 70 00 88 00 X....".....p...
00b0 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 .....
00c0 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 .....
00d0 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 70 00 .....p.
00f0 88 00 88 00 88 00 70 00 00 00 00 00 00 00 00 .....p.
0100 00 00 00 00 00 00 f0 00 08 00 08 00 08 00 f0 00 .....
0110 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00 .....@.
0120 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00 ..H.....
0130 80 00 40 00 38 00 40 00 80 00 00 00 00 00 f8 00 ..@.8.@.
0140 40 00 20 00 10 00 f8 00 00 00 00 00 70 00 88 00 @.....p...
0150 88 00 88 00 50 00 00 00 00 00 00 00 00 00 00 ....P.....
0160 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00 .....
0170 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00 80 00 .....
0180 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00 20 00 .....
0190 20 00 f8 00 00 00 00 00 48 00 00 00 00 00 00 00 .....H.....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0260 00 00 00 00 00 00 70 00 70 00 70 00 70 01 fc .....p.p.p.p.
0270 00 f8 00 70 00 20 00 00 00 00 .....p.

```

669. Packets 14899 through 15094 (the last 'grfd' packet in the trace) contain the same 'grfd' payload as packet 14893. For example, packet 14899:



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```
> Frame 14899: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 510287, Ack: 33161, Len: 568
> Data (568 bytes)

0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E-
0010 02 6c f6 37 40 00 40 06 af fa c0 a8 88 87 c0 a8  .l.7@.@ .....
0020 88 81 0d 9b 80 76 91 61 10 0a 7c 0a 52 0e 80 18  ....v.a...|.R...
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca eb 1e 02 6a  ....j
0040 19 8e 02 36 67 72 66 64 02 30 f8 7f a0 7f a0 24  ..6grfd.0.....$
0050 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00  .D@|.8.....
0060 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00  X....^..R..R..>..
0070 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00  .H`.x.?...0.@...
0080 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00  H.<~..R..R..r.2..
0090 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00  ....~..~..`.....
00a0 58 84 01 82 01 22 f9 fe 00 dc 00 00 70 00 88 00  X....".....p...
00b0 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00  ....
00c0 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00  ....
00d0 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
00e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 70 00  ....p.
00f0 88 00 88 00 88 00 70 00 00 00 00 00 00 00 00  ....p.
0100 00 00 00 00 00 00 f0 00 08 00 08 00 08 00 f0 00  ....@.
0110 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00  ....H.
0120 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00  .@.8.@.
0130 80 00 40 00 38 00 40 00 80 00 00 00 00 00 f8 00  @. ....p...
0140 40 00 20 00 10 00 f8 00 00 00 00 00 70 00 88 00  @. ....P...
0150 88 00 88 00 50 00 00 00 00 00 00 00 00 00 00  ....
0160 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00  ....
0170 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00 80 00  ....
0180 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00 20 00  ....
0190 20 00 f8 00 00 00 00 00 48 00 00 00 00 00 00 00  ....H.....
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0260 00 00 00 00 00 00 00 70 00 70 00 70 00 70 01 fc  ....p.p.p.p...
0270 00 f8 00 70 00 20 00 00 00 00  ..p. . .
```

670. The slimserver2 log entries are consistent with the network trace. Filtering the slimserver2 shows player-to-server IR codes and server-to-player SlimProto frames:

```
grep -P 'op IR |sending squeezebox frame' slimserver2-01.log
```

671. The filtered results show a last IR packet cluster at 01:31:37.6259 and 01:31:37.7183, representing the "right arrow" that initiates the sync. There are eight 'grfd' messages following the 01:31:37.6259 IR packet, with the eighth 'grfd' packet at 01:31:37.7886.

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The timestamp for that eighth 'grfd' packet (01:31:37.7886) is consistent with the network timestamp for packet 14893 (01:31:37.810231), modulo skew between the application logging and network timestamps.

```

2022-06-22 01:31:37.3184 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.5477 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.6259 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOBAL(0x9c33b68)
2022-06-22 01:31:37.6287 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.6543 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.6801 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7062 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7183 Got Slimproto frame, op IR , length 10, IO::Socket::INET=GLOBAL(0x9c33b68)
2022-06-22 01:31:37.7321 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7582 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7841 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7886 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.8101 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:38.3184 sending squeezebox frame: grfd, length: 562

```

672. Consequently, packet 14893 (01:31:37.810231) represents the 'grfd' message sent from slimserver2 to player1 with the post-sync screen:



673. We can now play music on player1 through slimserver2. After synchronizing player1 with player3, player1 is on while player2 and player3 are off.

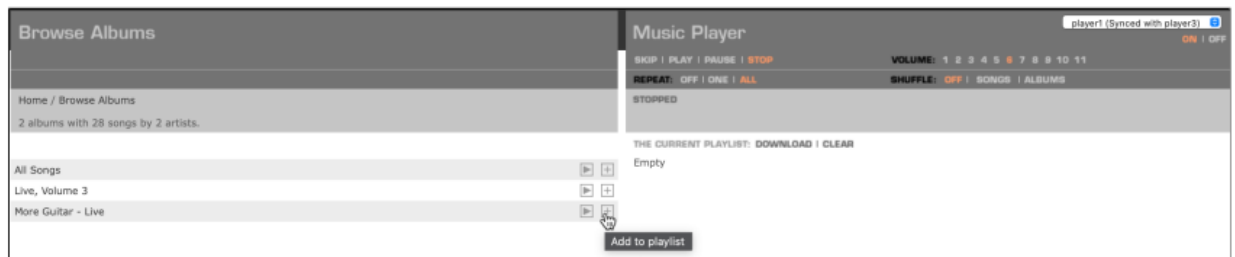
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```
[vmuser@slimserver2 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 361890235
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncgroupid = 361890235
```

674. Start a network trace:

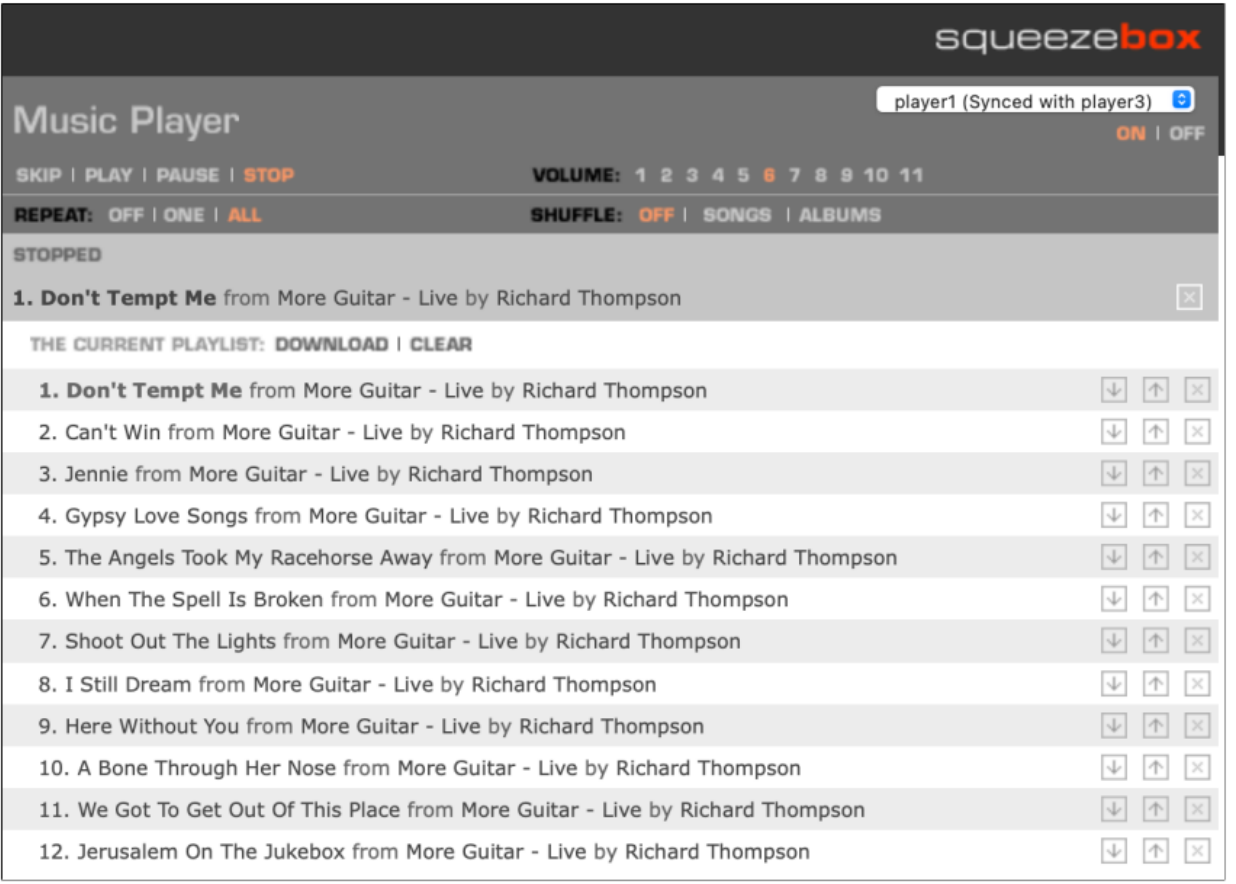
```
tcpdump -i eth0 -s 0 -w slimserver2-02.pcap
```

675. In the Web UI, select player1 and add an album ("More Guitar - Live") to the playlist.



676. The album tracks are added to player1's playlist. Track 1 ("Don't Tempt Me") is the current track. Playback is stopped.

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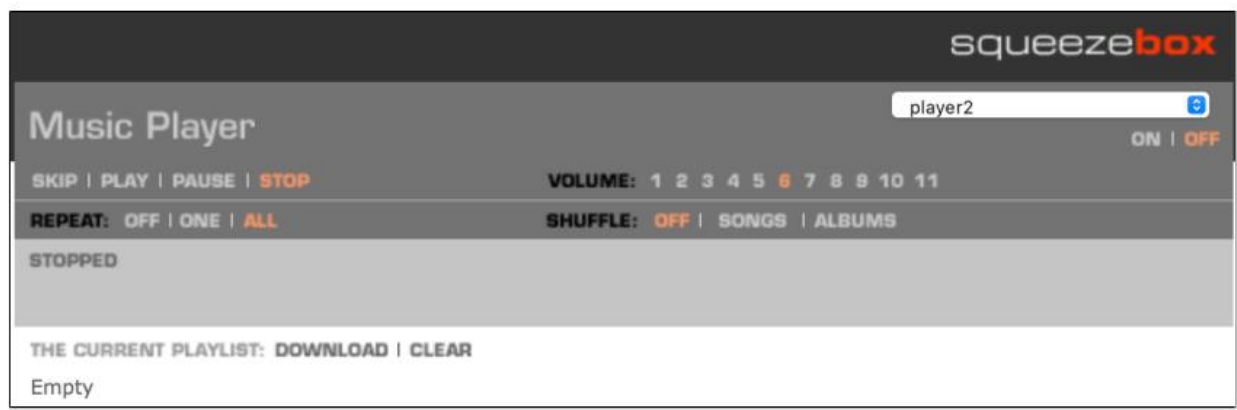


677. player1 shows "Don't Tempt Me" (1 of 12) as the current track. Playback is stopped.



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678. The Web UI shows player2 as stopped, with an empty playlist.

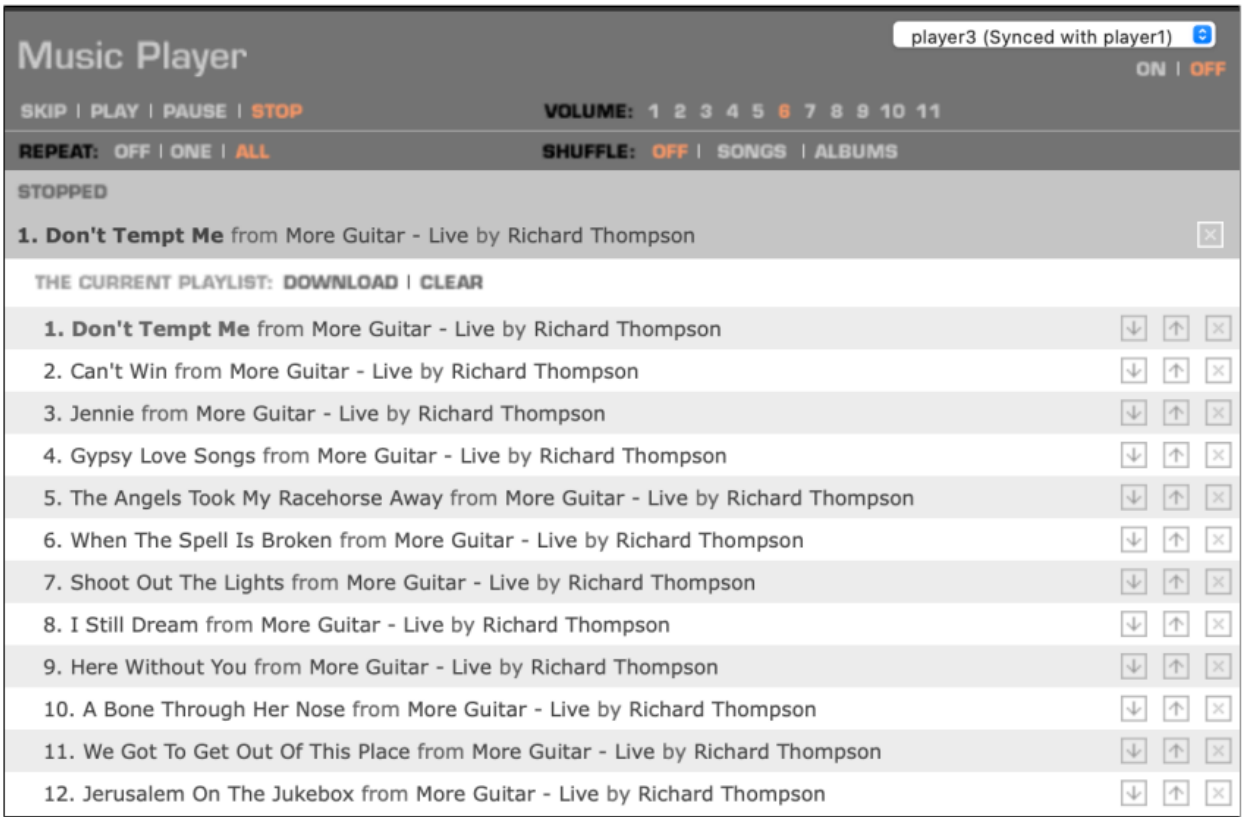


679. player2 is still powered off, in the screensaver.



680. The Web UI shows player3 as stopped with the same playlist as player1.

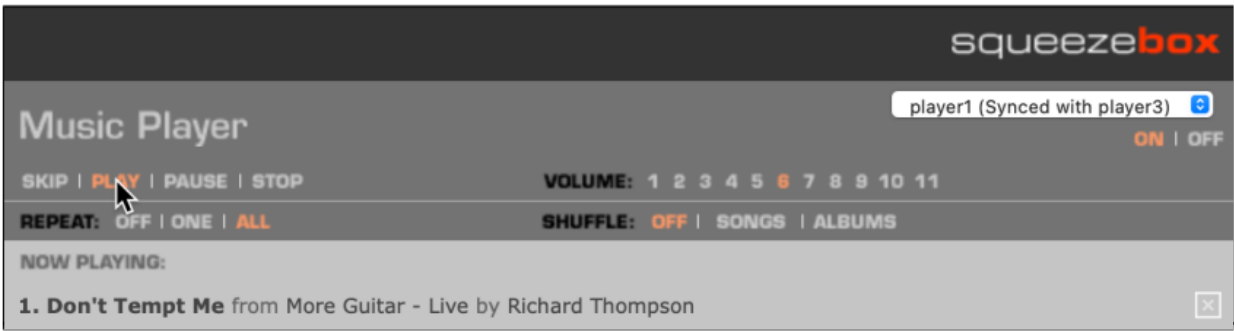
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681. player3 is still powered off, in the screensaver.



682. In the Web UI, Select player1 and press "PLAY."





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683. player1 plays "Don't Tempt Me" (1 of 12).



684. player2 is still powered off, in the screensaver.

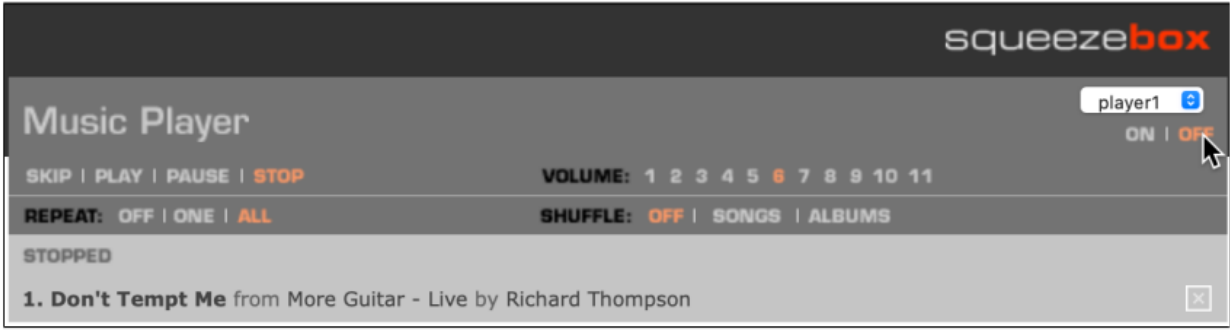


685. player3 is still powered off, in the screensaver.

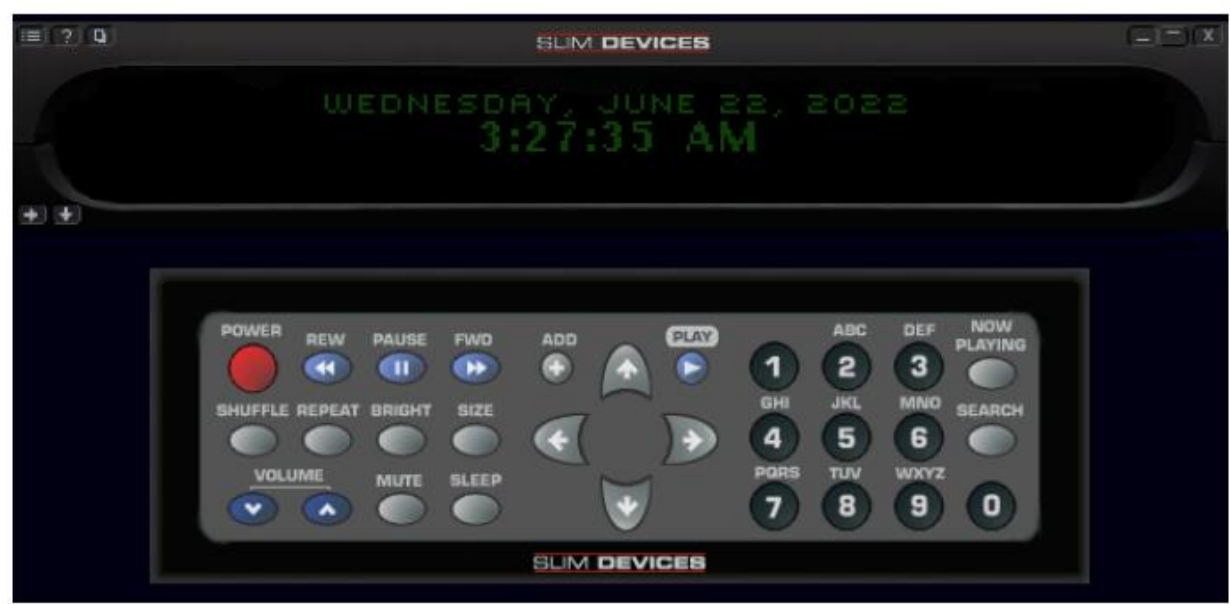


686. In the Web UI, power off player1.

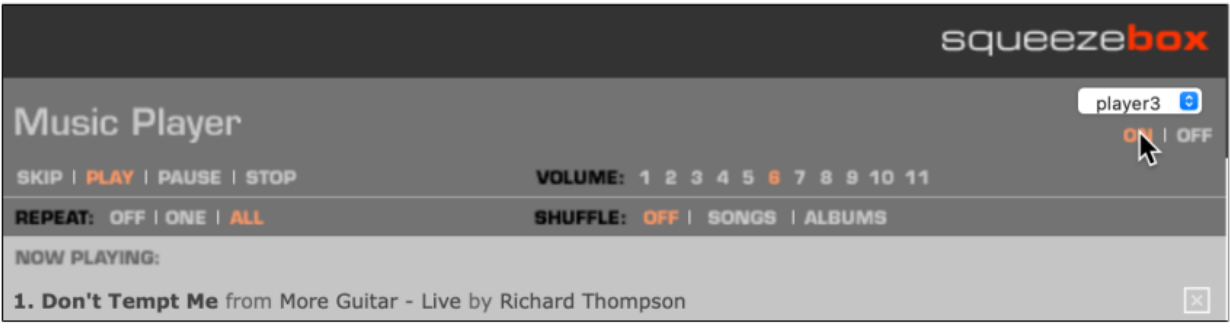
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687. player1 is powered off, in the screensaver.



688. In the Web UI, power on player3.



689. player3 plays "Don't Tempt Me" (1 of 12).

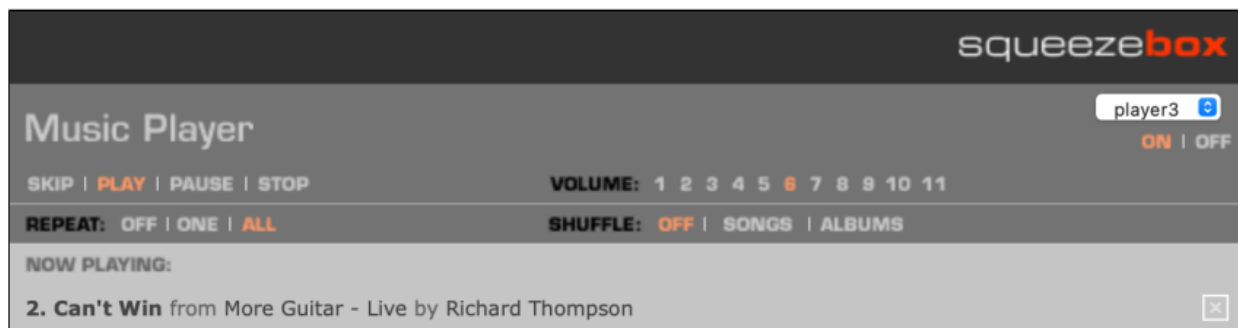
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690. player1 is still powered off, in the screensaver.

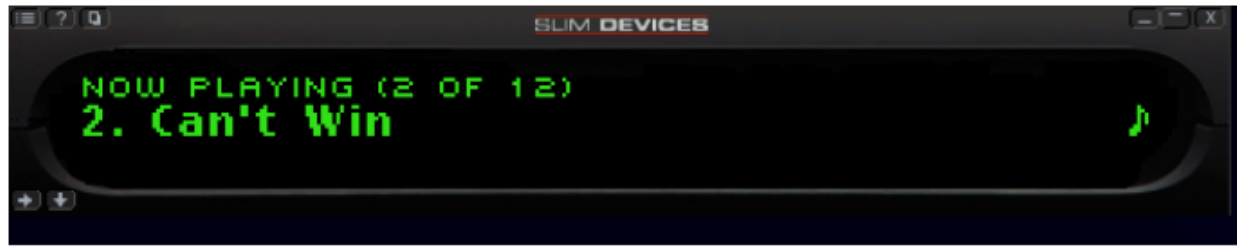


691. Wait until track 1 finishes playing. The Web UI shows player3 as playing track 2 ("Can't Win").

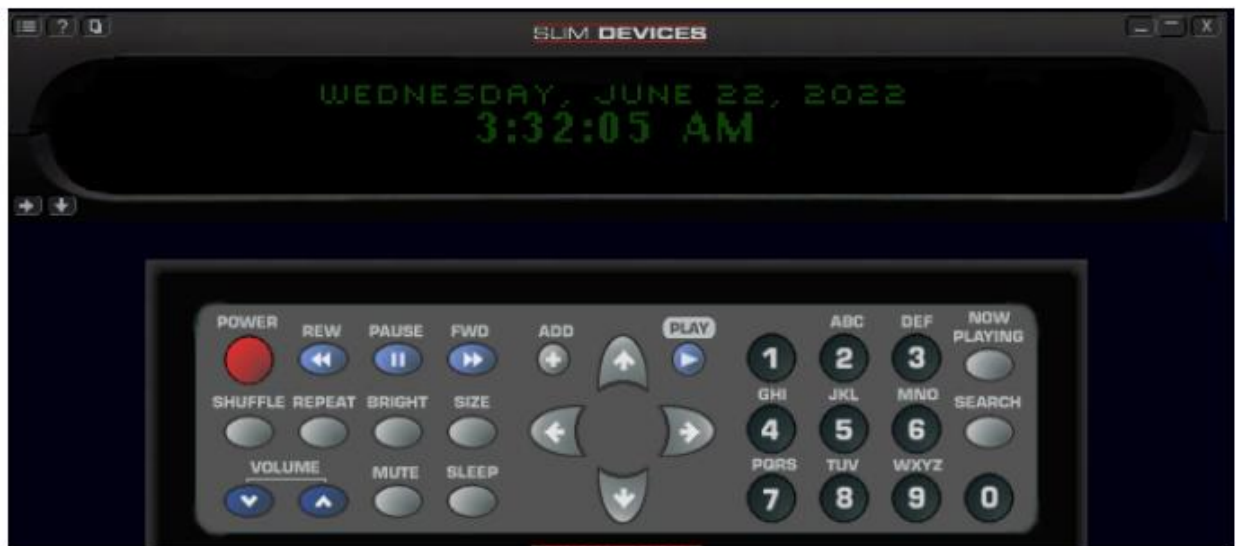


692. player3 plays "Can't Win" (2 of 12).

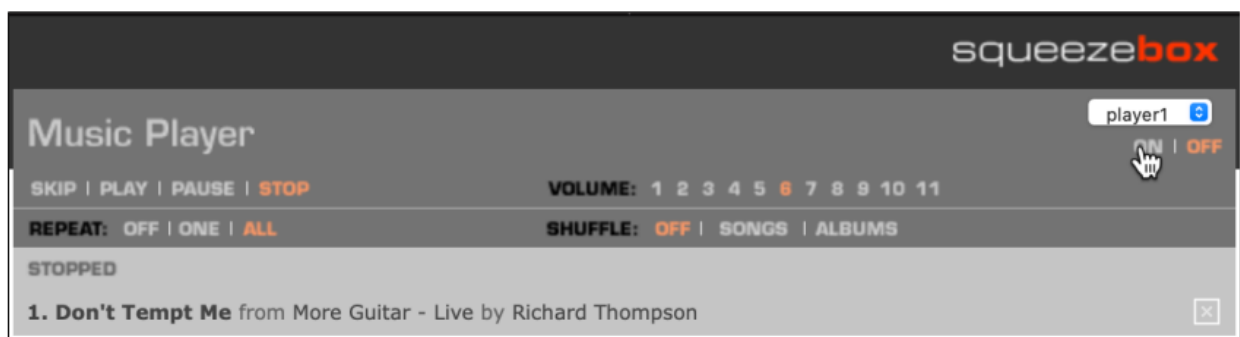
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693. player1 is still powered off, in the screensaver.

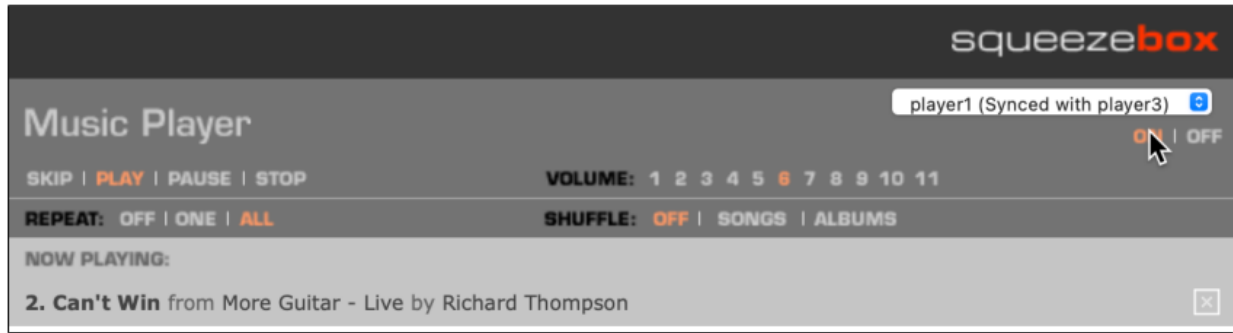


694. The Web UI shows player1 as off, stopped, and with track 1 still as the current track.



695. In the Web UI, power on player1. The Web UI shows player1 as on, playing, and with track 2 as the current track.

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696. player1's screen briefly shows the home screen:

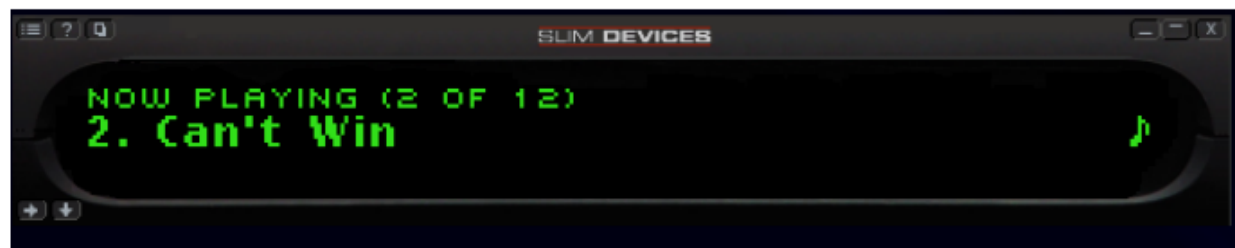


697. Before transitioning to playing "Can't Win" (2 of 12).

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698. player3 continues to play "Can't Win" (2 of 12).



699. At this point, in the Web UI, we can stop playback. As shown above, in the situation where (1) player3 is playing and (2) player1 is synchronized with player3 but off, then powering on player1 causes player1 to play along with player3.

700. Analyzing the tcpdump session data using Wireshark shows when each player is powered on. As discussed above regarding powering up a player to operate with a sync group, SlimServer sends a series of SlimProto messages when powering on a player. One of the SlimProto messages is a 'grfb' command, which sets the brightness to the power-on brightness level (as opposed to the dimmed brightness when off). Similarly powering off a player sends a 'grfb' command to set the brightness to the power-off brightness level. A 'grfb' packet carries the



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brightness code as the sole payload. The brightness code has five possible values (0, 1, 4, 16, 30), where 0 is the minimum and 30 is the maximum. Slim::Player::SqueezeboxG::brightness(), Slim/Player/SqueezeboxG.pm (v5.3.1), 80–91 at 88; Slim::Player::SqueezeboxG::maxBrightness(), Slim/Player/SqueezeboxG.pm (v5.3.1), 93–95; @Slim::Player::SqueezeboxG::brightnessMap, Slim/Player/SqueezeboxG.pm (v5.3.1), 78.

701. Identify 'grfb' packets using a WireShark display filter that selects for: source port 3483 — SlimProto from server to player; TCP len > 0 — to filter out pure ACKs; SlimProto command code "grfb".

```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfb"
```

702. There are three matching packets: packet 10349 — sent to player1 (192.168.136.129); packet 14761 — sent to player3 (192.168.136.131); packet 28545 — sent to player1 (192.168.136.129).

tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfb"							
No.	Time	Source	Destination	Protocol	Source Port	Destination Port	Length
10349	03:26:44.616435	192.168.136.135	192.168.136.129	TCP	3483	32886	74
14761	03:28:11.603682	192.168.136.135	192.168.136.131	TCP	3483	32885	74
28545	03:32:36.987532	192.168.136.135	192.168.136.129	TCP	3483	32886	74

703. Packet 10349 has brightness code 0x01 (1), which is very dim and represents dimming the display when powering off player1 (192.168.136.129).

```
> Frame 10349: 74 bytes on wire (592 bits), 74 bytes captured (592 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 164531, Ack: 11135, Len: 8
> Data (8 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo...);...E.
0010  00 3c 5f 29 40 00 40 06 49 39 c0 a8 88 87 c0 a8  <_)@.@ I9.....
0020  88 81 0d 9b 80 76 91 9c e1 1c 7c 0e 51 fa 80 18  ....v...|.Q...
0030  05 a8 92 88 00 00 01 01 08 0a 03 34 54 71 02 d3  .....4Tq...
0040  84 92 00 06 67 72 66 62 00 01  ..grfb..
```

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704. Packet 14761 has brightness code 0x1e (30), which is maximum brightness and represents brightening the display when powering on player3 (192.168.136.131).

```
> Frame 14761: 74 bytes on wire (592 bits), 74 bytes captured (592 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_b2:5e:60 (00:0c:29:b2:5e:60)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.131
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32885, Seq: 214433, Ack: 14441, Len: 8
> Data (8 bytes)
0000  00 0c 29 b2 5e 60 00 0c 29 3b b5 d2 08 00 45 00  ..)^...);...E
0010  00 3c b5 46 40 00 40 06 f3 19 c0 a8 88 87 c0 a8  <.F@.@.....
0020  88 83 0d 9b 80 75 93 59 d6 54 75 1d 5b 58 80 18  ....u.Y.Tu[X..
0030  05 a8 92 8a 00 00 01 01 08 0a 03 35 a8 a3 02 ae  ....5....
0040  28 bb 00 06 67 72 66 62 00 1e  (.grfb ..
```

705. Packet 28545 has brightness code 0x1e (30), which is maximum brightness and represents brightening the display when powering on player1 (192.168.136.129).

```
> Frame 28545: 74 bytes on wire (592 bits), 74 bytes captured (592 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 365611, Ack: 24511, Len: 8
> Data (8 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo...);...E
0010  00 3c 64 af 40 00 40 06 43 b3 c0 a8 88 87 c0 a8  <d.@.@.C.....
0020  88 81 0d 9b 80 76 91 9f f2 94 7c 0e 86 3a 80 18  ....v...|...:
0030  05 a8 92 88 00 00 01 01 08 0a 03 39 b6 38 02 d8  ....9.8..
0040  e6 87 00 06 67 72 66 62 00 1e  ..grfb ..
```

706. The SlimServer source code shows that, when powering on, the player sets the powerOnBrightness (ll. 224–229) and then restores the sync group (ll.230–231).

## Slim/Player/Player.pm (v5.3.1)

```
if ($on) {
    Slim::Buttons::Common::setMode($client, 'home');

    my $welcome = ($client->linesPerScreen() == 1) ? '' : Slim::Display::Display::
center(Slim::Utils::Strings::string('WELCOME_TO_' . $client->model));
    my $welcome2 = ($client->linesPerScreen() == 1) ? '' : Slim::Display::Display::
center(Slim::Utils::Strings::string('FREE_YOUR_MUSIC'));
    $client->showBriefly($welcome, $welcome2);

    # restore the saved brightness, unless its completely dark...
    my $powerOnBrightness = Slim::Utils::Prefs::clientGet($client,
"powerOnBrightness");

    if ($powerOnBrightness < 1) {
        $powerOnBrightness = 1;
    }
    Slim::Utils::Prefs::clientSet($client, "powerOnBrightness", $powerOnBrightness);
    #check if there is a sync group to restore
    Slim::Player::Sync::restoreSync($client);
}
```

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Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 217–231

707. Setting the brightness results in sending a 'grfb' command.

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 229;

Slim::Utils::Prefs::clientSet(), Slim/Utils/Prefs.pm (v5.3.1), 481–489 at 488;

Slim::Utils::Prefs::onChange(), Slim/Utils/Prefs.pm (v5.3.1), 312–327 at 320;

\$prefChange{'CLIENTPREFS'}{'powerOnBrightness'}, Slim/Utils/Prefs.pm (v5.3.1), 194–199 at 197.

**Slim/Player/SqueezeboxG.pm (v5.3.1)**

```
sub brightness {
    my $client = shift;
    my $delta = shift;

    my $brightness = $client->SUPER::brightness($delta, 1);
    if (!defined($brightness)) { $brightness = $client->maxBrightness(); }
    if (defined($delta)) {
        my $brightnesscode = pack('n', $brightnessMap[$brightness]);
        $client->sendFrame('grfb', \"$brightnesscode");
    }
    return $brightness;
}
```

Slim::Player::SqueezeboxG::brightness(), Slim/Player/SqueezeboxG.pm (v5.3.1), 80–91 at 88

Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm (v5.3.1), 514–533

708. After restoring the power-on brightness level, SlimServer restores the player to its sync group. When the master is in 'play' mode, SlimServer causes the client to jump to the current song in the master's playlist and transition from 'stop' mode to 'play' mode. SlimServer sends a 'strm' SlimProto command to the player to start playing the master's current song.

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 230–231

Slim::Player::Sync::restoreSync(), Slim/Player/Sync.pm (v5.3.1), 196–214 at 209

Slim::Player::Sync::sync(), Slim/Player/Sync.pm (v5.3.1), 132–167 at 159

Slim::Control::Command::execute(), Slim/Control/Command.pm (v5.3.1), 24–713 at 543

Slim::Player::Source::jumpto(), Slim/Player/Source.pm (v5.3.1), 604–640 at 614, 639

Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at

Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at 326–343, 393

Slim::Player::Squeezebox::play(), Slim/Player/Squeezebox.pm (v5.3.1), 99–107 at 104

Slim::Player::Squeezebox::stream(), Slim/Player/Squeezebox.pm (v5.3.1), 404–512 at 506

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Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm (v5.3.1), 514–533

**Command: "strm"**

This takes 16 bytes data of the form:

\$command	1 byte	's' start, 'p' pause, 'u' unpause, 'q' stop
\$autostart	1 byte	(buffer threshold to start playing at) '0' off, '1' 25%, '2' 50%, '3' 75%, '4' 100%
\$formatbyte	1 byte	'p' for pcm data, 'm' for mp3
\$pcmsamplesize	1 byte	'0' = 8, '1' = 16, '2' = 20, '3' = 32 usually '1' ('?' for mp3)
\$pcmsamplerate	1 byte	'0'=11kHz, '1'=22kHz, '2'=32kHz, '3'=44.1kHz, '4'=48kHz usually '3' ('?' for mp3)
\$pcmchannels	1 byte	'1'=mono, '2'=stereo usually '2' ('?' for mp3)
\$pcmendian	1 byte	'0' = big, '1' = little ('1' for wav, '0' for aif, '?' for mp3)
\$prebuffer_silence	1 byte	usually 5 (mpeg prebuffer x frames of silence)
\$spdif_enable	1 byte	'0'=auto, '1'=on, '2'=off usually 0
	1 byte	reserved
\$server_port	2 bytes	Server Port to use (9000 is the default)
\$server_ip	4 bytes	0 means use IP of control server

This is followed by an HTTP header itself. This is used to obtain the stream data eg:

```
GET /stream.mp3?player=$client-id HTTP/1.0
(Authorization: Basic $password)
(blank line)
```

The Auth line is only sent if authorization is in use. \$client-id is the usually the MAC address of the player and \$password is a password generated by the server.

[http://<SLIMSERVER\\_ADDR>:9000/html/docs/slimproto.html](http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html)  
<HTML/EN/html/docs/slimproto.html>

709. Consequently, when player1 powers on and rejoins an already-playing sync group, the SlimServer sends an 'strm' SlimProto message to the player to initiate playback. Isolate on SlimProto packets from SlimServer to player1 are by using a WireShark display filter that selects for: source port 3483 — from SlimServer; TCP payload length > 0 — filter out pure ACKs; destination IP is 192.168.136.129 — to player1 . . .

710. Which is expressed as:

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```
tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.129
```

tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.129							
No.	Time	Source	Destination	Protocol	Source Port	Destination Port	Length
28543	03:32:36.986751	192.168.136.135	192.168.136.129	TCP	3483	32886	634
28545	03:32:36.987532	192.168.136.135	192.168.136.129	TCP	3483	32886	74
28547	03:32:36.990998	192.168.136.135	192.168.136.129	TCP	3483	32886	132
28549	03:32:36.991542	192.168.136.135	192.168.136.129	TCP	3483	32886	148
28551	03:32:36.991937	192.168.136.135	192.168.136.129	TCP	3483	32886	132
28565	03:32:36.994092	192.168.136.135	192.168.136.129	TCP	3483	32886	132

711. As discussed above, slimserver1 sends a 'grfb' message in packet 28545 as part of the power-on sequence for player1 (192.168.136.129). The immediately following packets are: packet 28547 — 'i2cc'; packet 28549 — 'strm'.

```
> Frame 28547: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 365619, Ack: 24511, Len: 66
> Data (66 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E.
0010  00 76 64 b1 40 00 40 06 43 77 c0 a8 88 87 c0 a8  ..vd.@.@. Cw.....
0020  88 81 0d 9b 80 76 91 9f f2 9c 7c 0e 86 3a 80 18  ....v... |...:..
0030  05 a8 92 c2 00 00 01 01 08 0a 03 39 b6 3b 02 d8  ....9...<...
0040  e6 88 00 40 69 32 63 63 73 3e 77 68 77 e0 77 00  ..@i2cc s>whw.w.
0050  77 00 77 01 77 03 77 54 77 00 77 02 77 00 70 00  w.w.w.wT w.w.w.w.p.
0060  73 3e 77 68 77 e0 77 00 77 00 77 01 77 03 77 57  s>whw.w. w.w.w.wW
0070  77 00 77 02 77 00 70 00 73 3e 77 6c 77 00 77 10  w.w.w.p. s>wLw.w.
0080  77 76 70 00  wvp.
```

```
> Frame 28549: 148 bytes on wire (1184 bits), 148 bytes captured (1184 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 365685, Ack: 24511, Len: 82
> Data (82 bytes)
0000  00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00  ..)Eo... );...E.
0010  00 86 64 b3 40 00 40 06 43 65 c0 a8 88 87 c0 a8  ..d.@.@. Ce.....
0020  88 81 0d 9b 80 76 91 9f f2 de 7c 0e 86 3a 80 18  ....v... |...:..
0030  05 a8 92 d2 00 00 01 01 08 0a 03 39 b6 3c 02 d8  ....9...<...
0040  e6 8b 00 50 73 74 72 6d 73 30 6d 3f 3f 3f 3f 00  ..Pstrm s0m?????
0050  00 00 00 00 0d 9c 00 00 00 00 23 28 00 00 00 00  .....#(....
0060  47 45 54 20 2f 73 74 72 65 61 6d 2e 6d 70 33 3f  GET /str eam.mp3?
0070  70 6c 61 79 65 72 3d 64 62 3a 33 61 3a 35 32 3a  player=d b:3a:52:
0080  65 36 3a 37 30 3a 36 62 20 48 54 54 50 2f 31 2e  e6:70:6b HTTP/1.
0090  30 0a 0a 0a  0...
```

712. Consequently, packet 28549 represents the 'strm' message sent to player1 to initiate playback as part of restoring player1 to its sync group.

713. A network trace illustrates the synchronization confirmation message. A tcpdump

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session was initiated on the SlimServer host before using the directional buttons on the SoftSqueeze player1 remote to navigate to the "Synchronize" menu and then to select synchronization with player2 and player3. The session was terminated after the player transitioned from the pre-sync screen.



714. to the post-sync screen:





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715. We first identify the IR SlimProto packets, which send IR codes from the player to the SlimServer. The player sends an IR remote code using the SlimProto IR packet to the SlimServer for processing. An IR packet is a client-to-server message, which consists of:

Operation ("IR ") — offset 0, four bytes  
 Data Packet Length — offset 4, four bytes  
 Time — offset 8, four bytes  
 Format — offset 12, one byte  
 NoBits — offset 13, one byte  
 IRCode — offset 14, four bytes

#### Client -> Server Communications

A command to the server consists of three parts:

1. The 1st 4 bytes specify the operation. The following operations are supported:
  - HELO
  - IR (note the two spaces after IR)
  - RESP
  - STAT
  - BYE!
2. The 2nd part (of four bytes) is simply the length of the data packet (in Network order).
3. The 3rd part is the data itself.

**"IR "** (Note the two spaces to make it up to 4 characters.)

One of these packets is recieved for each IR code recieved by the player.

**Data Length:** Fixed at 10 bytes.

**Format:**

Time	4 bytes	Time since player startup in ticks (@1Khz)
Format	1 byte	Code Format (ignored by the server for now - Code represents type of IR code - NEC, JVC or Sony)
NoBits	1 byte	Length of IR Code (ignored by the server for now - 16 bits for JVC, 32 bits for NEC?)
IRCode	4 bytes	the IR Code itself (upto 32 bits)

[http://<SLIMSERVER\\_ADDR>:9000/html/docs/slimproto.html](http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html)  
<HTML/EN/html/docs/slimproto.html>

716. The "arrow\_right" IR code is 7689d02f.

arrow\_right, IR/Slim\_Devices\_Remote.ir (v5.3.1), 21

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717. The IR SlimProto packets are then identified using a WireShark display filter that selects for:

destination port 3483 — from player to SlimServer  
 data that begins with "IR " — the IR type  
 data that has 0x7689d02f in the four bytes beginning at offset 14

718. which is expressed as:

```
tcp.dstport == 3483 && data.data[0:4] == "IR " && data.data[14:4] == 76:89:d0:2f
```

719. There are six matching packets. The last packet (#277) represents the "arrow\_right" IR code that initiates the sync.

tcp.dstport == 3483 && data.data[0:4] == "IR " && data.data[14:4] == 76:89:d0:2f					
No.	Time	Source	Protocol	Info	
72	5.613	192.168.136.129	TCP	32824 → 3483	[PSH, ACK] Seq=229 Ack=2841 Win=4300 Len=18 TSval=4772482 TSecr=4895027
86	5.705	192.168.136.129	TCP	32824 → 3483	[PSH, ACK] Seq=247 Ack=5113 Win=4300 Len=18 TSval=4772574 TSecr=4895697
144	9.145	192.168.136.129	TCP	32824 → 3483	[PSH, ACK] Seq=453 Ack=10793 Win=4300 Len=18 TSval=4776014 TSecr=4899035
154	9.246	192.168.136.129	TCP	32824 → 3483	[PSH, ACK] Seq=471 Ack=13065 Win=4300 Len=18 TSval=4776115 TSecr=4899243
267	17.666	192.168.136.129	TCP	32824 → 3483	[PSH, ACK] Seq=793 Ack=20449 Win=4300 Len=18 TSval=4784534 TSecr=4907677
277	17.758	192.168.136.129	TCP	32824 → 3483	[PSH, ACK] Seq=811 Ack=22721 Win=4300 Len=18 TSval=4784626 TSecr=4907764

720. After packet 277, SlimServer responds with a series of 'grfd' command packets to the player. Each such packet begins with a two-byte length field and a four-byte command field. The server-to-player commands are identified using a WireShark display filter that selects for:

source port 3483 — from SlimServer to player  
 TCP length > 0 — to filter out pure acknowledgement packets  
 command code 'grfd'

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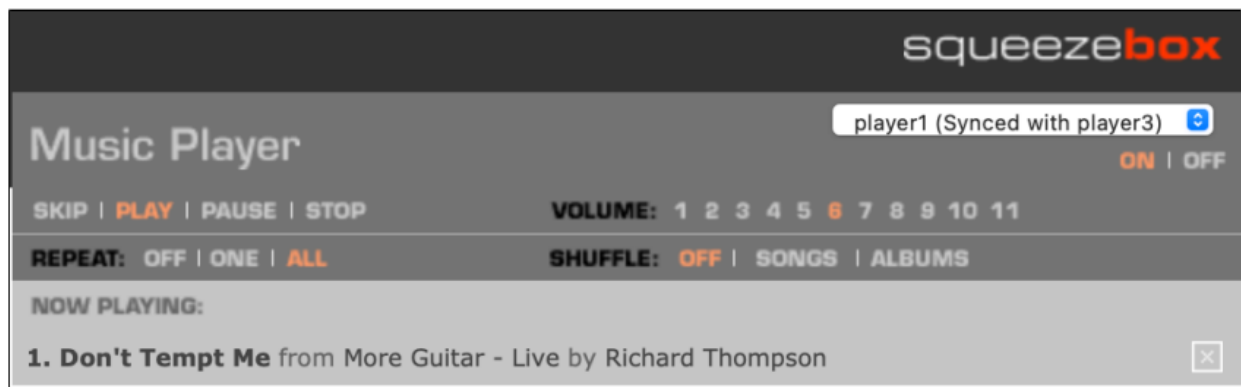
```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd"
```

No.	Time	Source	Protocol	Info
275	17.774	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=22133 Ack=811 Win=1448 Len=568 TSval=4907704 TSecr=4784390
278	17.774	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=22721 Ack=829 Win=1448 Len=568 TSval=4907790 TSecr=4784626
280	17.815	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=23289 Ack=829 Win=1448 Len=568 TSval=4907831 TSecr=4784683
282	17.826	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=23857 Ack=829 Win=1448 Len=568 TSval=4907842 TSecr=4784683
284	17.852	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=24425 Ack=829 Win=1448 Len=568 TSval=4907868 TSecr=4784694
292	18.653	192.168.136.128	TCP	3483 → 32814 [PSH, ACK] Seq=10225 Ack=723 Win=1448 Len=568 TSval=4908669 TSecr=3124568
294	18.657	192.168.136.128	TCP	3483 → 32813 [PSH, ACK] Seq=10225 Ack=723 Win=1448 Len=568 TSval=4908673 TSecr=3322027
296	18.661	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=24993 Ack=867 Win=1448 Len=568 TSval=4908677 TSecr=4784905
304	19.653	192.168.136.128	TCP	3483 → 32814 [PSH, ACK] Seq=10793 Ack=761 Win=1448 Len=568 TSval=4909669 TSecr=3125570
306	19.657	192.168.136.128	TCP	3483 → 32813 [PSH, ACK] Seq=10793 Ack=761 Win=1448 Len=568 TSval=4909673 TSecr=3323029
308	19.661	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=25561 Ack=905 Win=1448 Len=568 TSval=4909677 TSecr=4785907
316	20.654	192.168.136.128	TCP	3483 → 32814 [PSH, ACK] Seq=11361 Ack=799 Win=1448 Len=568 TSval=4910670 TSecr=3126572
318	20.658	192.168.136.128	TCP	3483 → 32813 [PSH, ACK] Seq=11361 Ack=799 Win=1448 Len=568 TSval=4910674 TSecr=3324031
320	20.662	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=26129 Ack=943 Win=1448 Len=568 TSval=4910677 TSecr=4786909
328	21.654	192.168.136.128	TCP	3483 → 32814 [PSH, ACK] Seq=11929 Ack=837 Win=1448 Len=568 TSval=4911670 TSecr=3127574
330	21.658	192.168.136.128	TCP	3483 → 32813 [PSH, ACK] Seq=11929 Ack=837 Win=1448 Len=568 TSval=4911674 TSecr=3325033
332	21.662	192.168.136.128	TCP	3483 → 32824 [PSH, ACK] Seq=26697 Ack=981 Win=1448 Len=568 TSval=4911678 TSecr=4787911

721. The network trace is also revealing for the power on sequence for a player in a sync group. For example, we begin with player1, player2, and player3 all in the same sync group, as shown by the preferences file.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

722. Leave player1 and player3 powered on. Power off player2. Play music in the sync group. player1 and player3 are actively playing music from the sync group's playlist, as shown in the Web UI.



723. player2 is unsynced, stopped, and not playing any playlist.

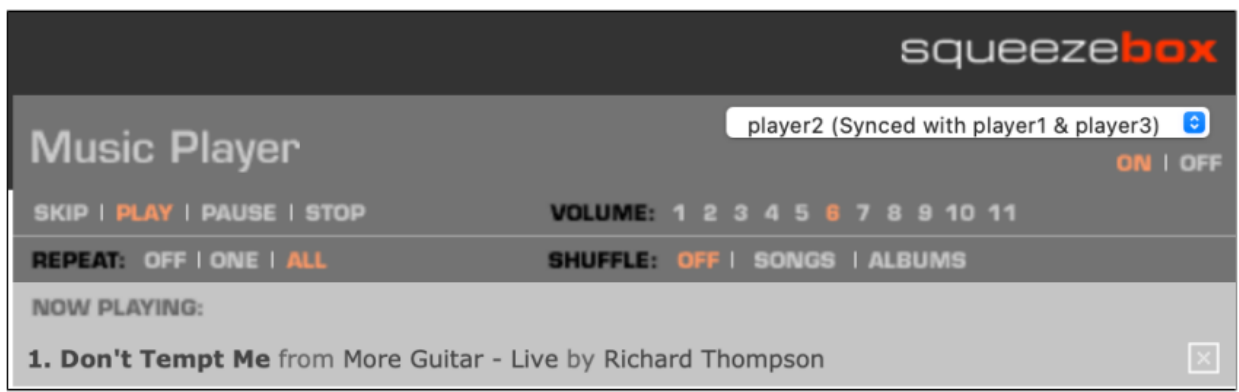
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724. player2's screen shows a dimmed screensaver with the date and time.



725. player2 synchronizes to player1 and player3, including starting playback of the same song.



726. player2's screen updates to eventually show a Now Playing screen, playing the current song in the sync group's playlist.

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727. And the corresponding network trace follows. A tcpdump session was initiated on the SlimServer host before pressing the "ON" button for player2 in the Web UI. The tcpdump session was terminated after player2 finishes powering up, rejoins the sync group, and begins playing. Analyzing the tcpdump session data using Wireshark shows the power-on network traffic from SlimServer (192.168.136.128) to player2 (192.168.136.130), including idle screen updates ('grfd') every second and a poweron sequence beginning at packet 65 (time 4.948) and ending at packet 130 (time 5.004). The SlimProto packets from SlimServer to player2 are then identified using a WireShark display filter that selects for:

source port 3483 — from SlimServer  
 TCP payload length > 0 — filter out pure ACKs  
 destination IP is 192.168.136.130 — to player2

728. which is expressed as:

```
tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.130
```

No.	Time	Source	Destination	Protocol	Info
1	0.000	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=1 Ack=1 Win=1448 Len=568 TSval=56391237 TSecr=54492416
13	1.000	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=569 Ack=39 Win=1448 Len=568 TSval=56392238 TSecr=54493418
25	2.001	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=1137 Ack=77 Win=1448 Len=568 TSval=56393239 TSecr=54494420
37	3.001	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=1705 Ack=115 Win=1448 Len=568 TSval=56394240 TSecr=54495422
52	4.002	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=2273 Ack=153 Win=1448 Len=568 TSval=56395241 TSecr=54496424
65	4.948	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=2841 Ack=191 Win=1448 Len=568 TSval=56396187 TSecr=54497426
67	4.949	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=3409 Ack=191 Win=1448 Len=8 TSval=56396188 TSecr=54497475
69	4.956	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=3417 Ack=191 Win=1448 Len=66 TSval=56396196 TSecr=54497475
71	4.957	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=3483 Ack=191 Win=1448 Len=82 TSval=56396196 TSecr=54497483
73	4.957	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=3565 Ack=191 Win=1448 Len=66 TSval=56396196 TSecr=54497483
102	4.964	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=3631 Ack=191 Win=1448 Len=66 TSval=56396203 TSecr=54497484
130	5.004	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=3697 Ack=191 Win=1448 Len=568 TSval=56396243 TSecr=54497490
994	6.003	192.168.136.128	192.168.136.130	TCP	3483 → 33001 [PSH, ACK] Seq=4265 Ack=305 Win=1448 Len=568 TSval=56397242 TSecr=54497597

729. Packets 1, 13, 25, 37, and 52 contain 'grfd' SlimProto messages with very similar



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data, consistent with minor time updates in the screensaver screen. For example, packet 1 (time 0.000) contains the following data:

```
> Frame 1: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 1, Ack: 1, Len: 568
> Data (568 bytes)

0000  00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00  ..)·W...·)·R...E·
0010  02 6c d7 ba 40 00 40 06 ce 7d c0 a8 88 80 c0 a8  ·l...@·@··}·.....
0020  88 82 0d 9b 80 e9 31 74 ee 21 2b 20 d2 25 80 18  ....1t·!+·%...
0030  05 a8 94 b2 00 00 01 01 08 0a 03 5c 76 45 03 3f  ....\vE·?
0040  7d 00 02 36 67 72 66 64 02 30 00 00 00 00 00 00  }··6grfd·0·.....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00d0  00 00 00 00 00 00 00 00 00 00 00 00 48 00 a8 00  .....H...
00e0  a8 00 a8 00 90 00 00 00 00 00 f0 00 08 00 08 00  .....@·...
00f0  08 00 f0 00 00 00 00 00 00 f8 00 40 00 20 00 10 00  .....·@·...
0100  f8 00 00 00 00 00 00 f8 00 88 00 88 00 88 00 70 00  .....p·
0110  00 00 00 00 78 00 a0 00 a0 00 a0 84 79 82 01 22  ....x...·y...
0120  01 fe 80 dc 40 00 38 00 40 00 80 66 00 66 00 00  ....@·8·@·f·f·
0130  04 00 08 86 01 8e 01 1a 01 f2 00 e2 00 00 00 00  ....".....
0140  00 00 10 dc 09 fe 09 22 09 fe f0 dc 00 00 00 00  ....f·f·.....
0150  f0 00 08 66 08 66 08 00 f0 00 00 fc 01 fe f9 02  A·.....
0160  41 fe 20 fc 10 00 f8 00 00 00 00 86 f9 8e a9 1a  ....@·...
0170  a9 f2 88 e2 00 00 00 00 00 00 00 00 00 00 00 00  ....@·...
0180  00 00 00 00 40 00 f9 fe 01 fe 01 10 01 f0 00 e0  @·.....px.....
0190  40 00 a8 00 a9 fe a9 e0 70 78 00 1e 00 0e 04 18  ....H·...
01a0  08 60 01 fe 01 fe 00 00 00 00 00 00 00 00 00 00  ....p·H·...p·
01b0  98 00 a8 00 a8 00 a8 00 48 00 00 00 00 00 70 00  ....p·
01c0  88 00 88 00 88 00 70 00 00 00 00 00 98 00 a8 00  ....H·...
01d0  a8 00 a8 00 48 00 00 00 00 00 98 00 a8 00 a8 00  ....H·...
01e0  a8 00 48 00 00 00 00 00 00 00 00 00 00 00 00 00  ....H·...
01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
```

730. Packet 52 (time 4.002) contains similar data to packet 1:



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```
> Frame 52: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 2273, Ack: 153, Len: 568
> Data (568 bytes)

0000 00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00 ..)·W...·)·R...E·
0010 02 6c d7 ca 40 00 40 06 ce 6d c0 a8 88 80 c0 a8 ·l...@·@·m.....
0020 88 82 0d 9b 80 e9 31 74 f7 01 2b 20 d2 bd 80 18 .....1t...+....
0030 05 a8 94 b2 00 00 01 01 08 0a 03 5c 85 e9 03 3f .....\\...?
0040 8c a8 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ..·6grfd·0.....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 48 00 a8 00 .....H...
00e0 a8 00 a8 00 90 00 00 00 00 00 f0 00 08 00 08 00 .....
00f0 08 00 f0 00 00 00 00 00 f8 00 40 00 20 00 10 00 .....@·...
0100 f8 00 00 00 00 00 00 f8 00 88 00 88 00 88 00 70 00 .....p·
0110 00 00 00 00 78 00 a0 00 a0 00 a0 84 79 82 01 22 ....x...·y..."
0120 01 fe 80 dc 40 00 38 00 40 00 80 66 00 66 00 00 .....@·8·@·f·f·
0130 04 00 08 86 01 8e 01 1a 01 f2 00 e2 00 00 00 00 .....
0140 00 00 10 dc 09 fe 09 22 09 fe f0 dc 00 00 00 00 .....
0150 f0 00 08 66 08 66 08 00 f0 00 00 fc 01 fe f9 02 ...f·f·...
0160 41 fe 20 fc 10 00 f8 00 00 00 00 7c f8 fe a9 42 A·...|...B
0170 a9 7e 88 3c 00 00 00 00 00 00 00 00 00 00 00 00 ~·<...
0180 00 00 00 00 40 00 f9 fe 01 fe 01 10 01 f0 00 e0 ...@·...
0190 40 00 a8 00 a9 fe a9 e0 70 78 00 1e 00 0e 04 18 @·...px·...
01a0 08 60 01 fe 01 fe 00 00 00 00 00 00 00 00 00 00 ·\·...
01b0 98 00 a8 00 a8 00 a8 00 48 00 00 00 00 00 70 00 .....H...p·
01c0 88 00 88 00 88 00 70 00 00 00 00 00 98 00 a8 00 .....p·
01d0 a8 00 a8 00 48 00 00 00 00 00 98 00 a8 00 a8 00 ...H·...
01e0 a8 00 48 00 00 00 00 00 00 00 00 00 00 00 00 00 ·H·...
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

731. Packet 65 contains a 'grfd' SlimProto message with markedly different contents, which is consistent with the Welcome screen that is shown briefly on power on.

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```

> Frame 65: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 2841, Ack: 191, Len: 568
> Data (568 bytes)

0000 00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00 ..)·W···)·R···E·
0010 02 6c d7 ce 40 00 40 06 ce 69 c0 a8 88 80 c0 a8 ·l·@·@·i·····
0020 88 82 0d 9b 80 e9 31 74 f9 39 2b 20 d2 e3 80 18 .....1t·9+····
0030 05 a8 94 b2 00 00 01 01 08 0a 03 5c 89 9b 03 3f .....\\···?
0040 90 92 02 36 67 72 66 64 02 30 00 00 00 00 00 00 ...6grfd·0·····
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00 00 00 .....
00e0 00 00 f8 00 a8 00 a8 00 88 00 00 00 00 00 f8 00 .....
00f0 08 00 08 00 09 fe 01 fe 01 20 71 20 89 00 88 00 ..... q····
0100 88 00 50 7e 00 7e 00 20 70 60 88 60 88 00 88 00 ..P~·~·p`····
0110 70 3c 00 7e 00 52 f8 52 40 72 20 32 40 00 f8 00 p<~·R·R·@r 2@···
0120 00 3c 00 7e f8 52 a8 52 a8 72 88 32 00 00 00 00 ·<~·R·R·r·2···
0130 00 00 00 00 00 00 00 00 00 00 80 00 80 60 f8 78 .....x
0140 80 3f 80 0c 00 30 00 40 70 00 88 00 88 3c 88 7e ·?···0·@p····<~
0150 70 42 00 42 00 7e 00 3c 00 00 00 00 00 7c 00 7e pB·B·~<····|~
0160 48 02 a8 04 a8 7e a8 7e 90 00 00 00 00 7e 70 7e H····~··~··~p~
0170 88 20 88 60 88 60 70 00 00 00 00 00 f8 00 a0 00 ····`p·····@~
0180 a0 00 80 00 00 00 00 7e 80 7e 80 20 f8 40 80 7e .....~··~·@~
0190 80 3e 00 20 00 40 48 7e a8 3e a8 00 a8 00 90 7c ·>··@H~·>····|
01a0 00 7e 00 02 70 04 88 7e a8 7e 98 00 78 00 00 32 ·~·p·~·~·x·2···
01b0 00 7a f0 5e 08 4c 08 00 08 00 f1 7e 01 7e 00 00 ·z·^·L····~··~
01c0 f8 00 a8 3c a8 7e 88 42 00 42 00 42 f8 00 a8 00 ·<~·B·B·B····
01d0 a8 00 88 00 00 00 00 00 88 00 98 00 a8 00 c8 00 .....
01e0 88 00 00 00 00 00 f8 00 a8 00 a8 00 88 00 00 00 .....
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

732. Packet 67 contains a 'grfb' SlimProto message, which is consistent with the message sent to restore the power-on brightness level.

```

> Frame 67: 74 bytes on wire (592 bits), 74 bytes captured (592 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 3409, Ack: 191, Len: 8
> Data (8 bytes)

0000 00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00 ..)·W···)·R···E·
0010 00 3c d7 d0 40 00 40 06 d0 97 c0 a8 88 80 c0 a8 ·<~@·@·i·····
0020 88 82 0d 9b 80 e9 31 74 fb 71 2b 20 d2 e3 80 18 .....1t·q+····
0030 05 a8 92 82 00 00 01 01 08 0a 03 5c 89 9c 03 3f .....\\···?
0040 90 c3 00 06 67 72 66 62 00 1e .....grfb··

```

733. Packet 69 contains an 'i2cc' SlimProto message, consistent with the message sent

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to restore volume.

```
> Frame 69: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 3417, Ack: 191, Len: 66
> Data (66 bytes)

0000  00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00  ..).W...).R...E.
0010  00 76 d7 d2 40 00 40 06 d0 5b c0 a8 88 80 c0 a8  ..v..@.@..[.....
0020  88 82 0d 9b 80 e9 31 74 fb 79 2b 20 d2 e3 80 18  ....1t..y+....
0030  05 a8 92 bc 00 00 01 01 08 0a 03 5c 89 a4 03 3f  ....\...?
0040  90 c3 00 40 69 32 63 63 73 3e 77 68 77 e0 77 00  ...@i2cc s>whw.w.
0050  77 00 77 01 77 03 77 54 77 00 77 02 77 00 70 00  w.w.w.wT w.w.w.p
0060  73 3e 77 68 77 e0 77 00 77 00 77 01 77 03 77 57  s>whw.w. w.w.w.wW
0070  77 00 77 02 77 00 70 00 73 3e 77 6c 77 00 77 10  w.w.w.p. s>wlw.w.
0080  77 76 70 00                                     wvp.
```

734. Packet 71 contains the 'strm' message used to tell player2 to start playing the current song in the sync group's playlist.

```
> Frame 71: 148 bytes on wire (1184 bits), 148 bytes captured (1184 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 3483, Ack: 191, Len: 82
> Data (82 bytes)

0000  00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00  ..).W...).R...E.
0010  00 86 d7 d4 40 00 40 06 d0 49 c0 a8 88 80 c0 a8  ....@.@..I.....
0020  88 82 0d 9b 80 e9 31 74 fb bb 2b 20 d2 e3 80 18  ....1t..+....
0030  05 a8 92 cc 00 00 01 01 08 0a 03 5c 89 a4 03 3f  ....\...?
0040  90 cb 00 50 73 74 72 6d 73 30 6d 3f 3f 3f 3f 00  ...Pstrm s0m????
0050  00 00 00 00 0d 9c 00 00 00 00 23 28 00 00 00 00  ....#(....
0060  47 45 54 20 2f 73 74 72 65 61 6d 2e 6d 70 33 3f  GET /stream.mp3?
0070  70 6c 61 79 65 72 3d 30 66 3a 35 39 3a 35 31 3a  player=0 f:59:51:
0080  36 34 3a 64 63 3a 64 37 20 48 54 54 50 2f 31 2e  64:dc:d7 HTTP/1.
0090  30 0a 0a 0a                                     0...
```

735. Packet 73 contains an 'i2cc' SlimProto message, consistent with the message sent to restore volume. The 'i2cc' payload is identical to packet 69's.

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```
> Frame 73: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 3565, Ack: 191, Len: 66
> Data (66 bytes)

0000  00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00  ..).W...).R...E.
0010  00 76 d7 d6 40 00 40 06 d0 57 c0 a8 88 80 c0 a8  .v..@.@.W.....
0020  88 82 0d 9b 80 e9 31 74 fc 0d 2b 20 d2 e3 80 18  ....1t..+....
0030  05 a8 92 bc 00 00 01 01 08 0a 03 5c 89 a4 03 3f  .......\...?
0040  90 cb 00 40 69 32 63 63 73 3e 77 68 77 e0 77 00  ...@i2cc s>whw.w.
0050  77 00 77 01 77 03 77 54 77 00 77 02 77 00 70 00  w.w.w.wT w.w.w.p.
0060  73 3e 77 68 77 e0 77 00 77 00 77 01 77 03 77 57  s>whw.w. w.w.w.wW
0070  77 00 77 02 77 00 70 00 73 3e 77 6c 77 00 77 10  w.w.w.p. s>wlw.w.
0080  77 76 70 00                                wvp.
```

736. Packet 102 contains an 'i2cc' SlimProto message, consistent with the message sent to restore volume. The 'i2cc' payload is identical to packet 69's and packet 73's.

```
> Frame 102: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 3631, Ack: 191, Len: 66
> Data (66 bytes)

0000  00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00  ..).W...).R...E.
0010  00 76 d7 d8 40 00 40 06 d0 55 c0 a8 88 80 c0 a8  .v..@.@.U.....
0020  88 82 0d 9b 80 e9 31 74 fc 4f 2b 20 d2 e3 80 18  ....1t..0+....
0030  05 a8 92 bc 00 00 01 01 08 0a 03 5c 89 ab 03 3f  .......\...?
0040  90 cc 00 40 69 32 63 63 73 3e 77 68 77 e0 77 00  ...@i2cc s>whw.w.
0050  77 00 77 01 77 03 77 54 77 00 77 02 77 00 70 00  w.w.w.wT w.w.w.p.
0060  73 3e 77 68 77 e0 77 00 77 00 77 01 77 03 77 57  s>whw.w. w.w.w.wW
0070  77 00 77 02 77 00 70 00 73 3e 77 6c 77 00 77 10  w.w.w.p. s>wlw.w.
0080  77 76 70 00                                wvp.
```

737. Packet 130 contains a 'grfd' SlimProto message, consistent with displaying the home screen after briefly showing the welcome screen.



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```
> Frame 130: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_83:57:01 (00:0c:29:83:57:01)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.130
> Transmission Control Protocol, Src Port: 3483, Dst Port: 33001, Seq: 3697, Ack: 191, Len: 568
> Data (568 bytes)

0000  00 0c 29 83 57 01 00 0c 29 a3 52 c6 08 00 45 00  ..)·W···)·R···E·
0010  02 6c d7 da 40 00 40 06 ce 5d c0 a8 88 80 c0 a8  ·l··@·@·]·····
0020  88 82 0d 9b 80 e9 31 74 fc 91 2b 20 d2 e3 80 18  ·····1t··+····
0030  05 a8 94 b2 00 00 01 01 08 0a 03 5c 89 d3 03 3f  ·····\···?···
0040  90 d2 02 36 67 72 66 64 02 30 49 fe a8 e0 a8 70  ···6grfd·0I···p
0050  a8 38 90 1c 01 fe 00 00 70 00 88 3c a8 7e 98 42  ·8·····p·<~·B
0060  78 42 00 7e 00 3c f0 00 08 00 08 40 08 78 f0 3e  xB·~·<···@·x·>
0070  00 1c 00 30 f8 7e a8 0e a8 38 88 40 00 00 00 00  ···0·~···8·@···
0080  f8 00 a8 00 a8 00 88 00 00 00 00 00 89 fe 99 fe  ······
0090  a9 10 c9 f0 88 e0 00 00 00 00 f9 fe a9 fe a8 00  ······
00a0  88 00 00 0c 00 5e f8 52 a8 52 a8 7e a8 3e 50 00  ····^·R·R·~>P·
00b0  00 00 00 60 70 78 88 3f 88 0c 88 30 70 40 00 00  ···px·?···0p@·
00c0  00 00 89 7e 51 7e 20 00 50 00 88 7e 00 7e 00 20  ···~Q~·P··~·~·
00d0  00 40 00 7e 00 3e 00 00 00 00 f8 38 20 7d 20 45  ·@·~>···8·}·E
00e0  20 45 f8 7f 00 7e 00 00 70 00 88 00 88 00 88 00  E··~·p·····
00f0  70 00 00 00 00 00 f8 00 40 00 20 00 40 00 f8 00  p·····@·@···
0100  00 00 00 00 f8 00 a8 00 a8 00 88 00 00 00 00 00  ······
0110  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0120  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0130  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0140  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0150  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0160  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0170  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0190  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
01a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
01b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
01c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
01d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
01e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
01f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
0250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ······
```

738. Release information is summarized below for the testing:

Release	Location	Notes
5.3.1	<a href="https://downloads.slimdevices.com/SlimServer_v5.3.1/">https://downloads.slimdevices.com/SlimServer_v5.3.1/</a>	The analyzed RPM and source code archives were originally downloaded from the Internet Archive, but the downloads were later determined to be binary-identical to the archives from downloads.slimdevices.com.  ZIP metadata shows source code dated 04-Oct-01.
6.2.1	<a href="https://downloads.slimdevices.com/SlimServer_v6.2.1/">https://downloads.slimdevices.com/SlimServer_v6.2.1/</a>	ZIP metadata shows source code dated 05-Nov-14.

739. The example and the evidence cited above clearly shows that the network device

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(slimserver1, slimserver2) sends an indication to the Squeezebox or SoftSqueeze (e.g., player1) that it has been added to a synchronization group. That synchronization group includes one Squeezebox or SoftSqueeze that is in at least one other group (e.g., player1 + player2), and both of the groups (player1 + player2 and player1 + player3) are configured to play back music synchronously when “invoked.”

**(b) Obviousness – POSITA**

740. In the alternative, this claim limitation discloses nothing more than overlapping speaker groups, which would have been obvious to a person of skill in the art at the time. Indeed, the Squeezebox already disclosed having groups and dynamic reallocation of those groups, which indicates to a person of skill in the art that overlapping group membership is desirable, consistent with Sonos’s arguments in its summary judgment briefing. A person of skill in the art would have been motivated to add overlapping groups because Squeezebox’s own marketing materials touted the flexibility of its system to allow users to play back media throughout their household. *Supra*.

741. A person of skill in the art would have recognized that by allowing a user to create speaker groups, those groups may either (1) allow overlapping group membership or (2) not allow overlapping group membership. Given that allowing overlapping group membership may be attractive to certain users because there was a recognized “need for dynamic control of the audio players as a group,” it would have been obvious to select allowing overlapping group membership when implementing speaker groups. ’885 patent at 2:18-19.

**(c) Obviousness – Nourse**

742. A person of skill in the art would also have been motivated to combine the Squeezebox with Nourse, which discloses a plurality of speakers, each of which has “a unique 16-bit address.” Nourse, 3:57-58. “Each of the speakers also can be assigned up to four group identifiers.” *Id.* at 3:58-59. The group identifier “allows specific speakers to be assigned to a



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group and receive the same signal.” *Id.* at 3:61-63. Thus, any speaker “can be assigned to more than one group.” *Id.* at 4:5. Nourse is analogous to the ’885 patent because it is in the same field of endeavor, “controlling or manipulating a plurality of multimedia players in a multi-zone system.” ’885 patent, 1:32-34. For example, Nourse, like the ’885 patent, explains that it is directed to “a centralized speaker system that allows multiple speakers connected to a central amplifier speaker line to be monitored and controlled from a central location via a master/slave protocol.” Nourse at Abstract. Nourse is also reasonably pertinent to the problem to be solved by the ’885 patent, which is “dynamic control of the audio players as a group.” For example, Nourse explains that speakers may be “addressed individually or as part of a group” by “receiving unique content specific, respectively, to the individual remote speaker address and group address” (*id.* at 2:35-39) where the group address or identifier “allows specific speakers to be assigned to a group and receive the same signal” and play back audio as a group (*id.* at 3:61-63). Nourse teaches additional means for improving the user experience by allowing a user to add a playback device to multiple groups. Nourse at 3:57-4:5. It would have been desirable to allow a user to have a particular zone player join multiple groups (*e.g.*, the kitchen and patio could be grouped for outside entertainment, and the kitchen and living room could be grouped for inside entertainment). Having a speaker join multiple groups would increase the number of customized combinations a user could configure in their home, as the Squeezebox recognizes as an important feature. Nourse is also analogous to the Squeezebox system as both relate to digital speaker systems with dynamic grouping features.

**(d) Obviousness – Rajapakse (US 8,239,559)**

743. A person of skill in the art would have found it obvious to combine Rajapakse with Squeezebox. Rajapakse was cited by many Sonos patents regarding speaker grouping, including patents from the same family as the ’885 patent, indicating that persons of skill in the art recognized

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that Rajapakse was highly relevant to the claimed features. For example, Mr. Lambourne in prosecuting US 2013/0251174 disclosed Rajapakse as relevant prior art. 2014-04-17 Information Disclosure Statement. Rajapakse was also cited by the following patents—which are closely related to the '885 patent.

US20130251174A1	Sonos, Inc.	Controlling and manipulating groupings in a multi-zone media system
US8788080B1	Sonos, Inc.	Multi-channel pairing in a media system
US9226087B2	Sonos, Inc.	Audio output balancing during synchronized playback
US9226073B2	Sonos, Inc.	Audio output balancing during synchronized playback
US9456279B1	Google Inc.	Automatic control and grouping of media playback devices based on user detection
US9671997B2	Sonos, Inc.	Zone grouping
US9729115B2	Sonos, Inc.	Intelligently increasing the sound level of player
US10209948B2	Sonos, Inc.	Device grouping
US10306364B2	Sonos, Inc.	Audio processing adjustments for playback devices based on determined characteristics of audio content
US10331399B2	Apple Inc.	Smart audio playback when connecting to an audio output system
US10356526B2	Razer (Asia-Pacific) Pte. Ltd.	Computers, methods for controlling a computer, and computer-readable media
US10516718B2	Google LLC	Platform for multiple device playout
US11265652B2	Sonos, Inc.	Playback device pairing

744. Rajapakse discloses this claim limitation.

745. For example, Rajapakse discloses dynamic playback among many speakers in groups. Rajapakse at 13:40-61 (“There may be multiple streams of audio being sent to multiple media renderers 203 in multiple zones at the same time. . . As an example, a media renderer may be the front left channel when a movie is being played to a screen that is centered between it and the front right. This would be configured as default movie stream. This same media renderer may be configured also to be the back left channel when playing a default HiFi audio stream, where hi performance front media renderers are positioned elsewhere in the room.”).

746. Rajapakse also discloses synchronized playback in speaker groups. Rajapakse at 11:60-65 (“The rendition of each stream by a media renderer 203 (speaker) needs to be

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synchronized in time. This is enabled by the distribution server 204 working with the media renderer 203, using a stream protocol specific to the media renderers 203. This protocol includes the methods to time-synchronize rendition of the stream.”).

747. Rajapakse discloses dynamic grouping and transitioning speakers among different groups. Rajapakse, 3:65-4:2 (“If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.”).

748. Rajapakse discloses that each player/speaker may be a part of multiple groups. Rajapakse at 4:47-52 (“Each media renderer 203 is set up with a variety of properties including lists of acceptable zone identifications, acceptable zone manager identifications, acceptable zone 50 control point identifications, lists of acceptable stream identifications, rendition properties such as volume and role properties.”).

749. Rajapakse discloses having many properties for players within a speaker group and therefore discloses “zone scenes.” Rajapakse, 4:53-5:5 (“One of these properties, the 'role' of a media renderer 203, can define what stream channel the media renderer 203 will 55 play back. Each audio data stream may include multiple channels, where each channel is defined as front left, center, front right, back left, back center, back right, subwoofer, etc. The media renderer 203 can be configured to accept one of the channels in the stream. If the stream does not contain the channel the media renderer 203 is configured for, it may be configured to play an alternate channel or not play anything. In addition to the channel type roles, a media renderer's role may include other 'roles.' A media renderer's role could be to play only deep base sounds, or to play only high pitch sounds in the media. As another example, a media renderer's role may be to provide special effects, such as echoes or background sounds. As a further example, a media renderer's role may be to play

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pre-recorded media segments at various points of the media stream. For example, a media renderer 203 may play pre-recorded media segments on initiation by a control point or zone manager, or based on sensing various states or conditions, such as powering up the media renderer, or detecting a sensor condition.”).

750. Rajapakse discloses overlapping groups or zones, and therefore overlapping speakers within those zones. Rajapakse at 5:61-67 (“A zone is a physical space that a number of media renderers belong to and within which the media renderers are physically located. Typically a zone is a listening space, a space where the audio from all the media renderers in the space can be heard. For example, all media renderers within a single auditorium will be in the same zone. Zones may overlap and may include other zones.”).

751. Rajapakse discloses that speakers may be a member of more than one group. Rajapakse at 6:2-4 (“Each media renderer 203 is assigned to one or more zones. Zones are typically identified with a Zone Identifier (ZID).”).

752. Rajapakse discloses dynamic zone and speaker management. Rajapakse at 6:6-41 (“The zone manager 210 dynamically gathers and aggregates information on the media renderers 203 in its vicinity and makes this information available to other services. . . . In addition to gathering media renderer information, the zone manager 210 holds information specific to a zone, manages the media renderers 203 in the zone, and may provide additional services and actions, such as media renderer reservation to other services such as control points 201. . . . The zone control point 209 is an enhanced version of a standard control point 201. The enhancements allow the zone control point 209 to interact with the zone manager 210 to quickly gather information on sets of media renderers 203 in a zone and perform actions on the zone.”).

753. Rajapakse discloses zone management that is dynamic. Rajapakse at 12:51-56 (“Once a zone manager 210 registers a media renderer 203, the zone manager 210 may view and

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modify the media renderer's setup by interacting with a user directly or via a control point 201. This includes modifying the media renderer's zone list, default stream list, role, and properties such as volume.”).

**(e) Obviousness – Millington**

754. A person of skill in the art would have been motivated to combine Millington with the Squeezebox because Mr. Millington worked on Sonos products that are in the same field of endeavor as the Squeezebox, and therefore it would have been an obvious choice to look to for guidance about potential modifications to that system. Mr. Millington’s patents also described aspects of the Sonos System or aspects related to how those systems practice group synchronization and therefore a POSITA would have looked to Millington to understand the Sonos System or its competitors, like Squeezebox. Indeed, as noted above, Sonos looked to Squeezebox when designing its own Sonos System. *See, e.g.,* SONOS-SVG2-00034518 at 52-55 (Lambourne ITC Dep. Tr.); Lambourne Dep. Tr. at 179:15-21 (in reference to competition with Squeezebox, stating that “[t]o some degree inasmuch that it was a streaming device, but I don’t think it we were looking to create something different.”). Millington was also assigned to Sonos and was filed in the same timeframe as the Sonos System was released.

755. Millington discloses this claim limitation.

756. Millington discloses standalone speakers and synchronous groups. Millington at 6 (“In the following, the term "synchrony group" will be used to refer to a set of one or more zone players that are to play the same audio program synchronously. Thus, in the above example, zone players 11(1) and 11(2) comprise one synchrony group, zone player 11(3) comprises a second synchrony group, zone players 11(4) and 11(5) comprise a third synchrony group, and zone player 11(6) comprises yet a fourth synchrony group. Thus, while zone players 11(1) and 11(2) are playing the same audio program, they will play the audio program synchronously.”); Millington

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at 6-7 (“Similarly, while zone players 11(4) and 11(5) are playing the same audio program, they will play the audio program synchronously.”).

757. Millington discloses using dynamic groups. Millington at 7 (“In the network audio system 10, the synchrony groups are not fixed. Users can enable them to be established and modified dynamically. Continuing with the above example, a user may enable the zone player 11(1) to begin providing playback of the audio program provided thereto by audio information source 14(1)(1), and subsequently enable zone player 11(2) to join the synchrony group. Similarly, a user may enable the zone player 11(5) to begin providing playback of the audio program provided thereto by audio information source 14(5)(2), and subsequently enable zone player 11(4) to join that synchrony group. In addition, a user may enable a zone player to leave a synchrony group and possibly join another synchrony group. For example, a user may enable the zone player 11(2) to leave the synchrony group with zone player 11(1), and join the synchrony group with zone player 11(6). As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.”); Millington at 41 (“The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.”).

758. Millington discloses overlapping speaker groups. Millington at 17 (“As noted above, there may be multiple synchrony groups in the network audio system 10, and further that, for example, a zone player 11(n) may operate both as a master device 21 or a slave device 22(g) in one synchrony group, and as the audio information channel device 23 providing audio and playback timing information and clock timing information for another synchrony group.”); Millington at 19 (“Indeed, it will be appreciated that the zone player that is utilized as the audio



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information channel device for synchrony group 20(2) may also be a zone player that is utilized as the master device 21(1) or a slave device 22(1)(1),..., 22(K)(1) in the synchrony group 20(1).”).

**(f) Obviousness – Lindemann**

759. A person of skill in the art would have found it obvious to combine Lindemann with the Squeezebox. Lindemann was cited by many digital speaker patents regarding speaker grouping, including patents from the same family as the ’885 patent, indicating that persons of skill in the art recognized that Lindemann was highly relevant to the claimed features. For example, US 2013/0251174 cited to Lindemann. Lindemann and the Squeezebox are both in the same field of endeavor. Lindemann Abstract (“A digital wireless loudspeaker system includes an audio transmission device for selecting and transmitting digital audio data, and wireless speakers for receiving the data and broadcasting sound.... Status messages are included in the transmission frames to control speaker attributes such as speaker group, enabling or disabling a sub-woofer, and volume of the loudspeaker digitally.”).

760. Lindemann discloses overlapping speaker groups. Lindemann at 0064 (“Many homes and offices have multiple groups of loudspeakers—*e.g.*, a group of loudspeakers in the living room and another group in the kitchen. The Group Selection Switch allows a loudspeaker to be assigned to one of many groups of loudspeakers.”).

**21. Limitation 1.8: “after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation;”**

761. In my opinion, the Sonos System discloses this claim limitation.

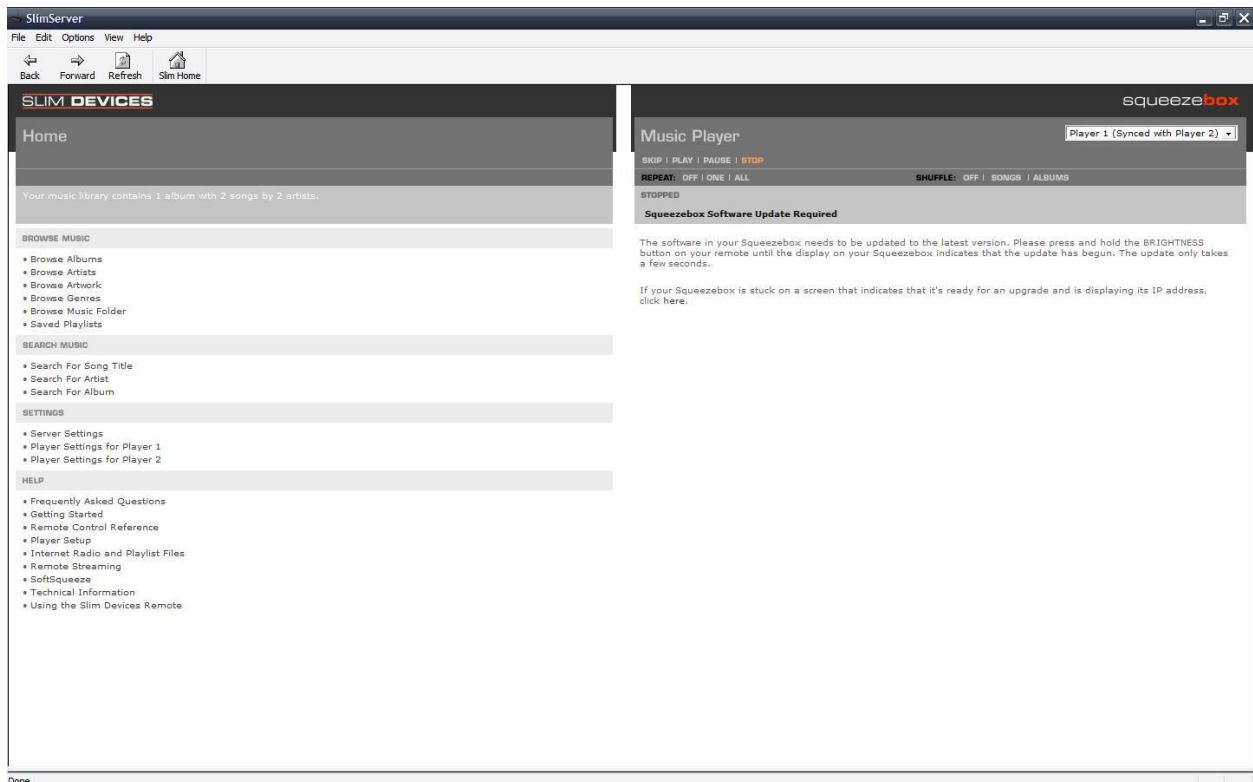
762. Sonos argues that this claim limitation is disclosed based on arguments made in its Reply summary judgment briefing, as discussed *supra*. As discussed therein, Sonos argues that having a “zone scene” that is not automatically activated discloses the limitation.

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**22. Limitation 1.9: “after the given one of the first and second zone scenes has been selected for invocation, receiving, from the network device over the data network, an instruction to operate in accordance with a given one of the first and second zone scenes respectively comprising a given one of the first and second predefined groupings of zone players; and”**

800. In my opinion, Squeezebox discloses this claim limitation.

801. In Squeezebox, a user may select a synchronization group for playback using the player selector in the upper right corner of the SlimServer. The SlimServer provides playback controls in the Music Player section to cause the Squeezeboxes to operate as a synchronous playback group.



802. The source code confirms that this claim limitation is met.

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803. When a "play" command is sent to a player, for example by pressing the "PLAY" button in the Web UI, SlimServer sends a 'strm' SlimProto command to the player to play the master's current song. *See, e.g.:*

Slim::Web::HTTP::processURL(), Slim/Web/HTTP.pm (v5.3.1), 483–581 at 575

Slim::Control::Command::execute(), Slim/Control/Command.pm (v5.3.1), 24–713 at 216

Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at 327–343, 393 Slim::Player::Squeezebox::play(), Slim/Player/Squeezebox.pm (v5.3.1), 99–107 at 104 Slim::Player::Squeezebox::stream(), Slim/Player/Squeezebox.pm (v5.3.1), 404–512 Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm (v5.3.1), 514–533

**Command: "strm"**

This takes 16 bytes data of the form:

\$command	1 byte	's' start, 'p' pause, 'u' unpause, 'q' stop
\$autostart	1 byte	(buffer threshold to start playing at) '0' off, '1' 25%, '2' 50%, '3' 75%, '4' 100%
\$formatbyte	1 byte	'p' for pcm data, 'm' for mp3
\$pcmsamplesize	1 byte	'0' = 8, '1' = 16, '2' = 20, '3' = 32 usually '1' ('?' for mp3)
\$pcmsamplerate	1 byte	'0'=11kHz, '1'=22kHz, '2'=32kHz, '3'=44.1kHz, '4'=48kHz usually '3' ('?' for mp3)
\$pcmchannels	1 byte	'1'=mono, '2'=stereo usually '2' ('?' for mp3)
\$pcmendian	1 byte	'0' = big, '1' = little ('1' for wav, '0' for aif, '?' for mp3)
\$prebuffer_silence	1 byte	usually 5 (mpeg prebuffer x frames of silence)
\$spdif_enable	1 byte	'0'=auto, '1'=on, '2'=off usually 0
	1 byte	reserved
\$server_port	2 bytes	Server Port to use (9000 is the default)
\$server_ip	4 bytes	0 means use IP of control server

This is followed by an HTTP header itself. This is used to obtain the stream data eg:

```
GET /stream.mp3?player=$client-id HTTP/1.0
(Authorization: Basic $password)
(blank line)
```

The Auth line is only sent if authorization is in use. \$client-id is the usually the MAC address of the player and \$password is a password generated by the server.

<http://:9000/html/docs/slimproto.html>

<HTML/EN/html/docs/slimproto.html>

804. Any changes to the play mode, including starting play, are also done on all the synced clients that are not silent.

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Slim/Player/Source.pm (v5.3.1)

```
# when we change modes, make sure we do it to all the synced clients.
foreach my $everyclient ($client, Slim::Player::Sync::syncdWith($client)) {

    $::d_source && msg($everyclient->id() . " New play mode: " . $newmode . "\n");

    next if Slim::Utils::Prefs::clientGet($everyclient,'silent');
```

...

Slim/Player/Source.pm (v5.3.1)

```
} elsif ($newmode eq "play") {

    $everyclient->readytosync(0);
    $everyclient->volume($client->volume(),1);
    $everyclient->streamBytes(0);
    $everyclient->play(Slim::Player::Sync::isSyncd($everyclient), $master->streamformat());
```

Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at 345–350, 388–393

805. The evidence relevant to this claim limitation is recited in the prior limitation described above. The power on (grfd, i2cc) instructs the Squeezebox or SoftSqueeze players to operate in accordance with the group.

**23. Limitation 1.10: “based on the instruction, transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players such that the first zone player is configured to coordinate with at least one other zone player in the given one of the first and second predefined groupings of zone players over a data network in order to output media in synchrony with output of media by the at least one other zone player**

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**in the given one of the first and second predefined groupings of zone players.”**

806. In my opinion, Squeezebox discloses this claim limitation.

807. The evidence disclosing this claim limitation is described above, which transitions the Squeezebox or SoftSqueeze player from playing (or not playing) independently of the group to play in accordance with the group. As described above, the Squeezeboxes coordinate through master and slave communication to output music in synchrony, and the strm/play messages cause the speaker to operate in accordance with the claimed “zone scene.”

808. Further, as described in the previous claim limitation, a user may select a synchronization group for playback using the Player selector box, and use the playback controls to cause the Squeezeboxes to operate as a synchronous playback group. At the time that the synchronization group is selected and media is output from the synchronization group, the Squeezeboxes discontinue their previous playback and begin playing back as part of the synchronization group.

### **C. Obviousness Type Double Patenting Over U.S. Patent No. 9,141,645**

809. U.S. Patent No. 9,141,645 (“the ‘645 patent”) claims priority to an application filed on July 8, 2003 and it issued on September 22, 2015. Claims 1-6 of this patent are included below, which have similar scope to the remaining claims 7-17:

1. A multimedia controller including a processor, the controller configured to:
  - receive, at the controller via a packet network, a zone group configuration;
  - display, via a user interface, a plurality of zones, each zone containing at least one zone player to playback multimedia content from a multimedia source;
  - receive, via the user interface, a first user input, the first user input selecting a first zone of the plurality of zones and, wherein the first user input instructs the first zone of the plurality of zones to play a first multimedia content;
  - receive, via the user interface, a second user input, the second user input identifying at least one additional zone of the plurality of zones to be grouped with the first zone into a zone group, such that the zone group will synchronously play the first multimedia content currently being played by the first zone;

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nothing that Dr. Almeroth cites establishes that groups would be “destroyed” by changing the audio source.

**41. Limitation 1.6: “(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked; and”**

899. In my opinion, the Bose LifeStyle discloses this claim limitation.

900. As I discussed *supra* in Sections VIII and IX, Sonos argued that adding a speaker to a speaker group via a controller and sending an “indication” that need not include the “zone scene” or the players in that zone scene is sufficient to meet this claim element.

901. Bose Lifestyle discloses this behavior. As discussed above and further below, Bose LifeStyle allows for the addition of multiple rooms and zones to be added to the Lifestyle ecosystem, and provides for the ability to operate in multiple rooms.



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**Connecting additional rooms**

Follow the placement guidelines for the Bose® powered speakers that you plan to connect. Then review your plan for how to connect these speakers to the multi-room interface in your primary room. If you have questions or need extension cables to complete the connections, call Bose Customer Service at the numbers listed on the back inside cover of this owner's guide.

**CAUTION:** Make sure all components are unplugged from the power outlet before you begin hooking up additional speakers.

Connect the audio input cable from your additional powered speakers to the selected ROOM jack on the back of the multi-room interface.

1. Plug the small black multi-pin connector (flat side facing up) into the jack marked ROOM B, C, or D on the back of the interface.
2. Follow the instructions that came with your speakers for connecting the cable to the speakers.

**Note:** Be sure that each connector is inserted completely into each jack.

**Figure 47**

ROOM jacks on the multi-room interface



Room A, B, C, and D jacks

*Id.* at 40. See also, BOSE\_SUB-0000361-448.

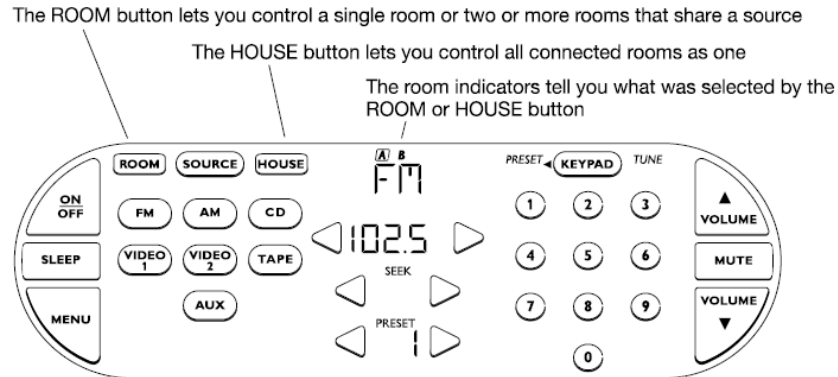
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**Operating in more than one room**

Your Lifestyle® 50 system can control up to four sets of Bose® powered speakers, allowing your family to enjoy different audio sources (CD, radio, TV, etc.) in up to four rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal™ music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 48 shows an example display for a two-room system.

**Figure 48**

Example display for a two-room system

**Understanding the room indicators**

- ☒ **A** A boxed letter indicates the presently-selected room or rooms. The selected room is affected by any source changes, or any change you make using the VOLUME, MUTE, ON/OFF, or SLEEP buttons.
- ☐ **B** An unboxed letter indicates a room listening to a **shared source**. A shared source is one that is playing in the controlled room as well as in up to three additional rooms. If you change the radio station, CD track, etc., of the shared source, the change affects all rooms sharing this source. However, you cannot change sources for all affected rooms at the same time. The VOLUME, MUTE, ON/OFF, and SLEEP buttons only affect the boxed room(s).
- ☐ An empty box appears for each connected room when you press the HOUSE button. When you change the volume in the HOUSE mode, the numerical level appearing on the display does not represent the actual volume level in all connected rooms. It only represents the actual volume in rooms represented by a boxed letter.

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## **Using the ROOM button**

The ROOM button allows you to select any connected room and control any sound source you want to hear in that room. Each time you press the ROOM button you can transfer control from one room to the next in A-B-C-D order. The room indicators on the display tell you what is currently selected. Rooms listening to a shared source can be linked and controlled as one room.

### **Turning on different sources in more than one room**

Let's say you have a two-room system (rooms A and B) and the entire system is off. To turn on a different source in each room:

1. Wake up the Personal™ music center.
2. Press the ROOM button until the room indicator **[A]** is displayed. Press a source button, such as VIDEO 1, to turn on the system and listen to your DVD player in room A. Adjust the volume to the desired level.
3. Press the ROOM button again. The room indicator **[B]** is displayed. Press a different source button, such as CD, to listen to a CD in room B. Again, adjust the volume to the desired level.
4. Press the ROOM button again and notice that the room indicator **[A]** is displayed. You are controlling room A once again and the displays indicates that the VIDEO 1 source is on.

### **Setting up a shared source**

Now, let's say the system is already on and you want to play the FM radio in rooms A and B:

1. Wake up the Personal music center.
2. Press the ROOM button until the room indicator **[A]** is displayed. Press the FM source button and adjust the volume to the desired level for room A.
3. Press the ROOM button again to select room **[B]**. Press the FM source button and adjust the volume to the desired level for room B. Now, the indicators **A [B]** are displayed.
4. Press the ROOM button again. The indicators **[A] [B]** appear on the display indicating that you can control these two rooms together. Any button command given now (SOURCE, VOLUME, MUTE, ON/OFF, SLEEP) is applied to both rooms.

**Note:** Remember that there are limits to using different sources in different rooms. With one tuner, the system cannot play one radio station in one room and another radio station in another. Similarly, with one CD changer, the system cannot play two different CDs at the same time.

## **Linking rooms for common control**

There are two ways to link rooms in order to control them as one.

- Set up a shared source in two or more rooms and select them together using the ROOM button. See "Setting up a shared source" above.
- Link all connected rooms using the HOUSE button. See "Using the HOUSE button" on page 43.

## **Returning to single-room control**

After you have gained control of multiple rooms using the ROOM button, you can use the ROOM button again to gain control of a single room. Press ROOM until the room you want is displayed (**[A]**, **[B]**, **[C]**, or **[D]**). Control that room as desired.

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*Id.* at 43.

### **Using the HOUSE button**

Using the HOUSE button, you can link all rooms together and control them as one. When you press the HOUSE button, an empty box indicator is displayed for each connected room. Any button pressed after that (any source button, VOLUME, MUTE, or SLEEP) affects every room. When you are done listening you can press OFF to turn off the entire system.

**Note:** *If you do not press any additional buttons after pressing HOUSE, pressing HOUSE again cancels HOUSE mode.*

Press the HOUSE button before each command to apply that command to all rooms:

<b>Press ...</b>	<b>To do this ...</b>
HOUSE then a source	Play the selected source in all connected rooms.
HOUSE then VOLUME ▲▼	Adjust the volume up or down by the same amount in all rooms that are on, or all connected rooms if they are all off. The system remembers the differences among the original room volume settings.
HOUSE then MUTE	Silence all connected rooms that are on, even if any were previously muted individually. To cancel this command, press HOUSE then MUTE again. Any rooms that were muted before this command was given stay silent until individually unmuted. If you unmute an individual room after it was muted by a HOUSE - MUTE command, the other rooms remain silent until each one is unmuted individually. Pressing HOUSE then VOLUME ▲ unmutes all muted rooms.
HOUSE then SLEEP	Set the SLEEP timer for all rooms that are on. The SLEEP time selected applies to all rooms that are on even if they are playing different sources. If the SLEEP timer was already set in one or more rooms, the display shows the longest time already set. You can accept this time or change it for all the rooms. To cancel the HOUSE - SLEEP command, press HOUSE, SLEEP, CLEAR, and then DONE.
HOUSE then OFF	Turn off the entire system.

**Note:** *Instead of setting the whole house to one sleep time, you can set different sleep times for individual rooms by using the ROOM button to select each room and setting SLEEP.*

*When two or more rooms are linked, adjusting the SLEEP time affects all linked rooms (indicated by boxed letters).*

*Id.* at 43.

902. Further, and as evidenced below, for example, Bose Lifestyle explicitly allows for multiple zones and operation.

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7.0 User Interface Operation

7.5 Multi-zone paging user interface operation

The Multi-zone paging user interface provides keys to select single paging zones, all paging zones and initiate a page.

Paging zones are not the same as output zones. After assigning the PAGE source to the output zones and choosing the appropriate settings in the Page Setup control pane, flashing the hardware maps the paging zone buttons accordingly.

When mapped, the paging zone 1 button will select the lowest numbered output ZONE to which the PAGE source is assigned, and so forth.

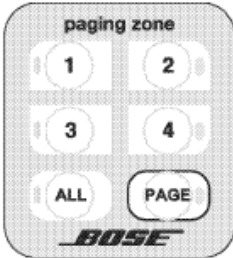
**Multi-Zone Paging User Interface**

Select paging zone #1

Select paging zone #2

Select paging zone #3

Select all paging zones

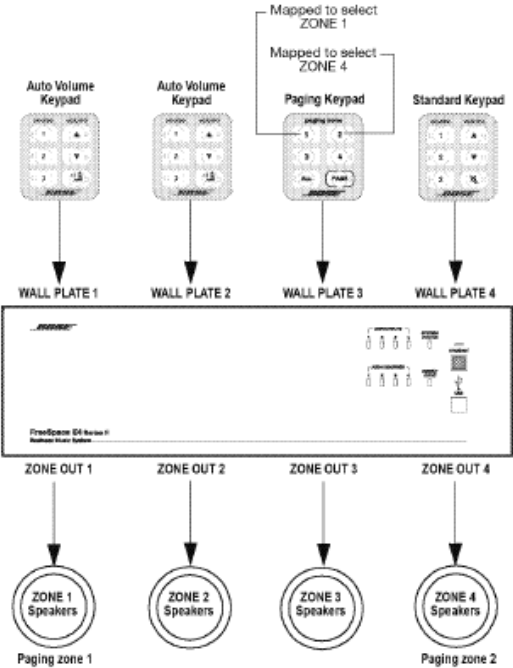


Select paging zone #4

Initiate a page

- Press **1**, **2**, **3** or **4** to select a paging zone. A green LED flashes to indicate that the zone is selected for paging. After ending a page the LED turns off.
- Press **ALL** to select all paging zones.
- Press **PAGE** to initiate a page in systems that do not use a PTT microphone.

- Paging User Interface Example:**
- The **PAGE** source is assigned to ZONE OUT 1 and ZONE OUT 4.
  - In the Page Setup control pane for ZONE 1 and ZONE 4:
    - Paging Type** = Multi-zone
    - PAGE Control** = Wall plate 3
  - After flashing the hardware, the paging zone **1** button selects ZONE OUT 1 for paging, and the paging zone **2** button selects ZONE OUT 4 for paging.





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Figure 1: Two-Zone System

Example System: Small Market

The store is comprised of two zones, the main retail area and the cashier area. The main retail area receives music and paging, and operates at a fixed volume level.

The cashier area also receives music and paging, but its volume is controlled by the Auto Volume function and an Auto Volume wall plate.

		Zone 1 Retail	Zone 2 Cashier	Zone 3	Zone 4
Sources	Music	•	•		
	Paging	•	•		
Controls	Standard Wallplate	•			
	Auto Volume Wallplate		•		



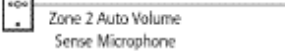
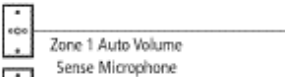
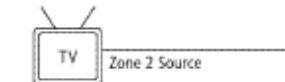
Figure 2: Four-Zone System

Example System: Restaurant

The restaurant is comprised of four zones: dining, bar, patio, and the restrooms and lobby. All zones receive the music source, and the bar and lobby area receive paging. The bar area also can select the television audio source.

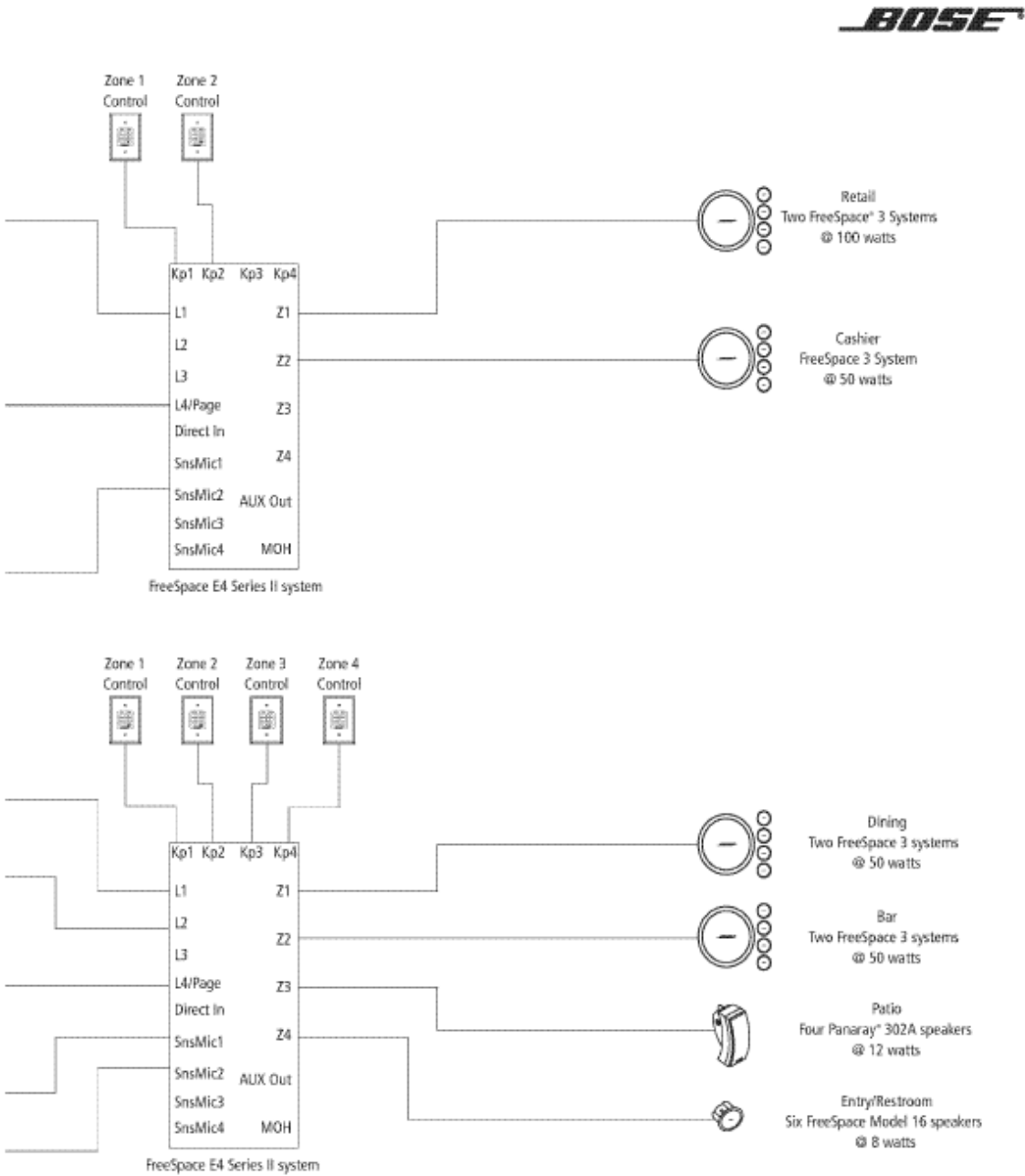
The dining and bar areas' volume is controlled by the Auto Volume function. The remaining zones, the patio and restrooms/lobby, are controlled using standard wall plate controls. A multi-zone paging interface is connected to the wall plate number four connection to provide independent paging of the two page zones.

		Zone 1 Dining	Zone 2 Bar	Zone 3 Patio	Zone 4 Entry/Restrooms
Sources	Music	•	•	•	•
	TV		•		
	Paging		•		•
Controls	Standard Wallplate			•	•
	Auto Volume Wallplate	•	•		





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6 OF 8

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BOSE\_SUB-0000145

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903. Bose LifeStyle also allows for playing in multiple rooms.

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## Setting Up Your Lifestyle® Stereo Amplifier

### Multi-room interface setup

English

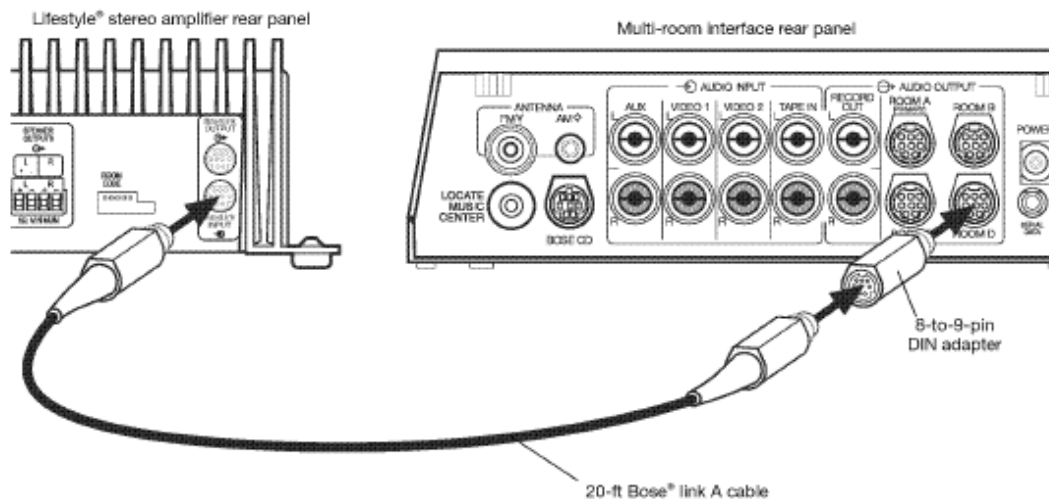
**CAUTION:** Before making any connections, turn the Lifestyle® system off and disconnect the music center from the AC (mains) power outlet. DO NOT plug the amplifier into an outlet until you have completed all other connections.



1. Insert the 8-to-9-pin adapter into one of the unused ROOM output connectors (B, C, or D) on the rear of the multi-room interface (Figure 10).
2. Insert one end of the Bose® link A cable into the 8-to-9-pin adapter.
3. Insert the other end of the Bose® link A cable, into the Bose® link input connector on the rear panel of the Lifestyle® stereo amplifier.

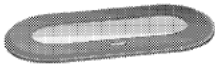
**Figure 10**

Lifestyle® stereo amplifier  
to multi-room interface  
connections



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Setting Up Your Lifestyle® Stereo Amplifier



Setting up the Personal® music center

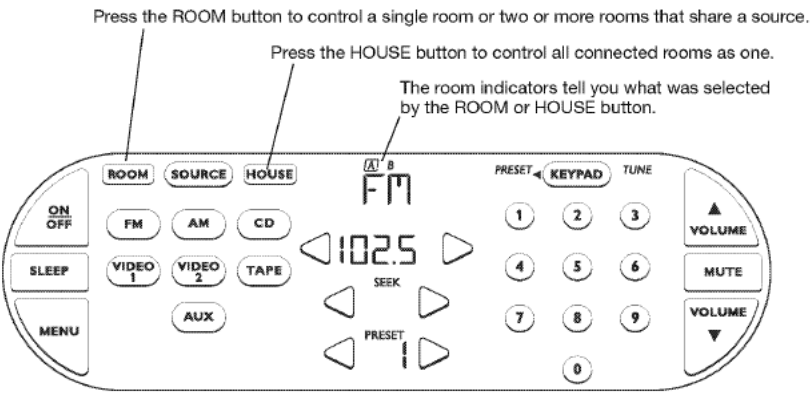
Systems that have a multi-room interface are controlled by the Personal® music center which requires no internal switch settings before it allows you to control more than one room of speakers. However, if you purchase a second Personal® music center, you must follow the procedure for setting up the Personal® music center for the first time.

**Note:** Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.

Selecting other rooms with the Personal® music center

The Personal® music center allows you to control up to four sets of Bose® powered speakers placed in individual rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal® music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 11 shows a sample display for a two-room system.

**Figure 11**  
Sample display for a two-room system



BOSE\_SUB-0000290.

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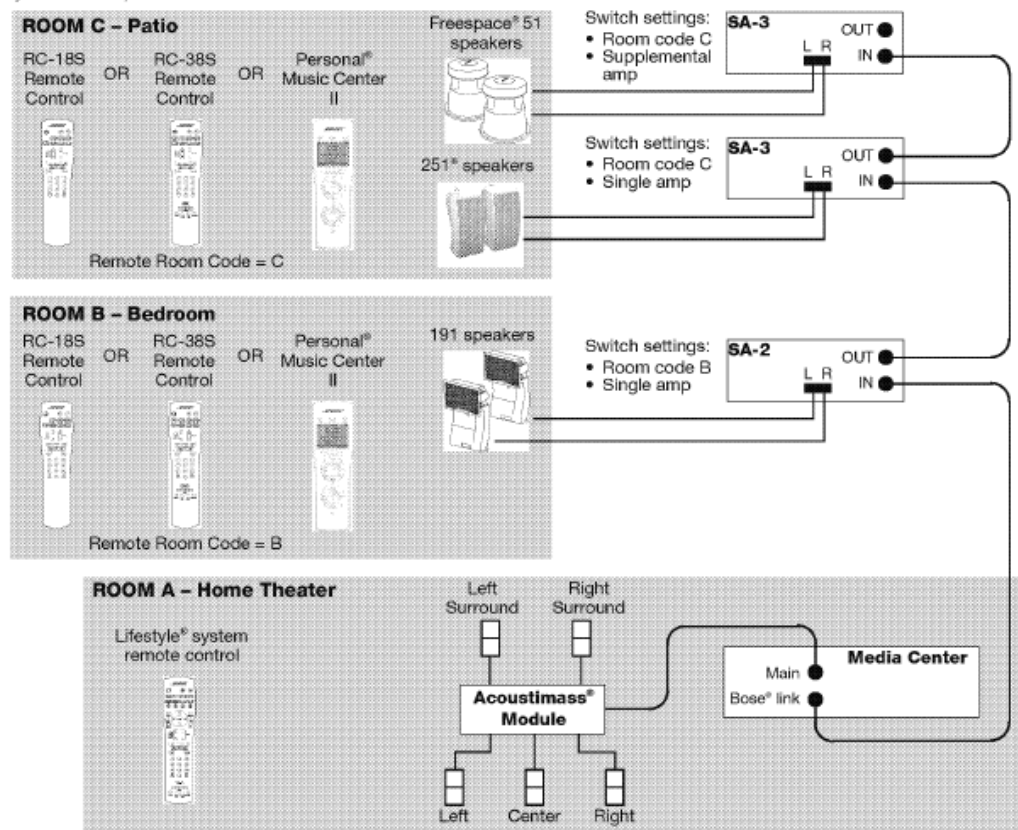
**Setting Up Additional Rooms For Sound****Setup guidelines for additional rooms**

If you have a Lifestyle® 18 series II, 28 series II, 38 or 48 home entertainment system, you can experience stereo sound in up to 14 other rooms using Lifestyle® stereo amplifiers, compatible speaker systems and remote controls for the other rooms.

- Remote controls for other rooms must be set to the same house code as the main room remote, but each remote must be set to a different room code. See "Setting up remote controls for other rooms" on page 23.
- The Lifestyle® amplifier and its remote control must be set to the same room code. See "Setting up the amplifier room code" on page 24.
- When using more than one amplifier to power more than two speakers in a room (Figure 18, room C), all amplifiers must be set to the same room code. Also, one amplifier must be set to the single amp mode and all others must be set to the supplemental amp mode. See "Single and supplemental amplifiers" on page 25.

**Figure 18**

Sample installation of  
Lifestyle® stereo amplifiers



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Setting Up Additional Rooms For Sound

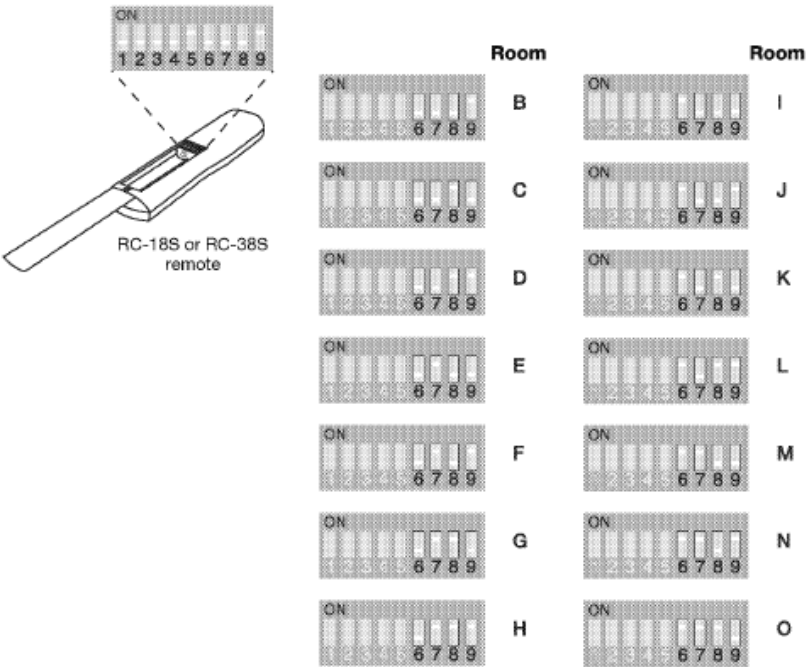
Setting up remote controls for other rooms

To set up the RC-18S or RC-38S remote:

- 1. Remove the remote control battery cover and locate the microswitches (Figure 19).
- 2. Make sure that the house code settings (switches 1, 2, 3, and 4) match the house code settings in your main room remote.
- 3. This remote is shipped from the factory set for room B. If this remote is used beyond a second room, set switches 6, 7, 8, and 9 to the same room code as set in the Lifestyle® stereo amplifier.

**Note:** Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.

Figure 19  
Microswitch settings for  
RC-18S and RC-38S  
remotes

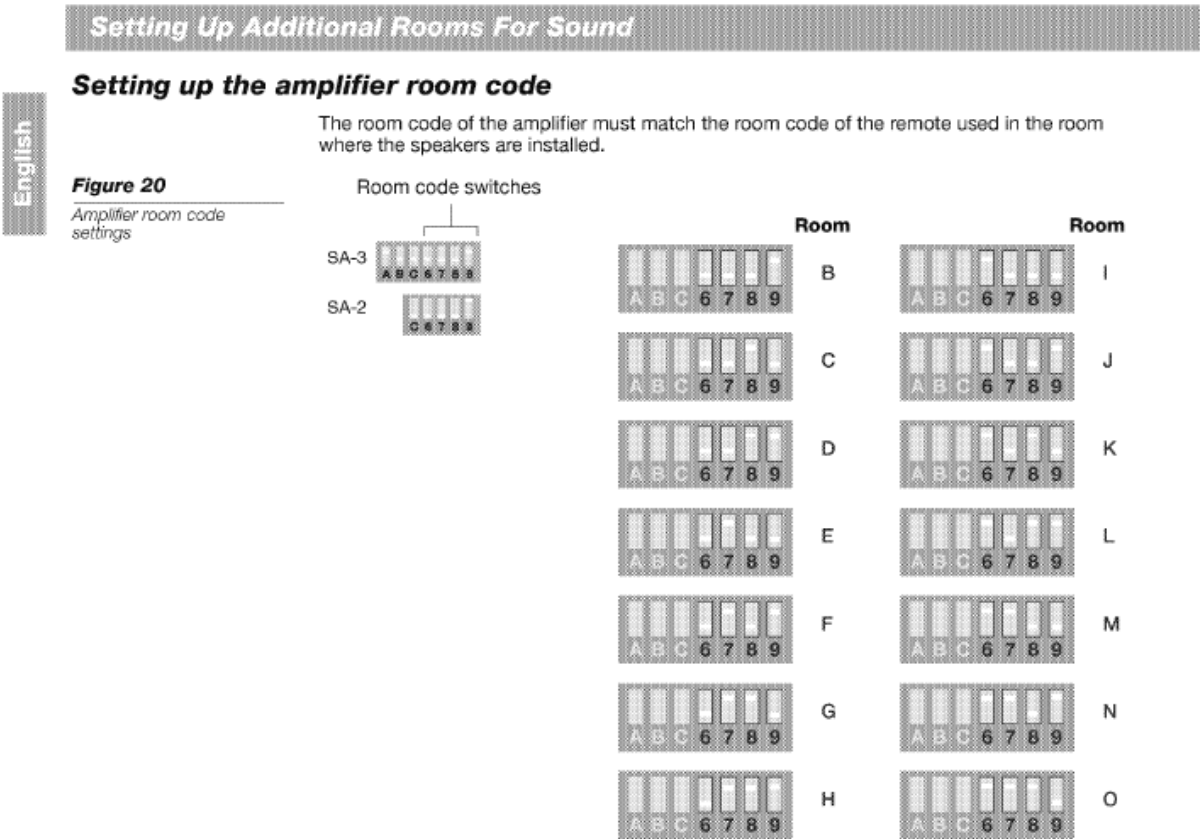


To set up the Personal® music center II:

Refer to the owner's guide included with the Personal® music center II for instructions on configuring this remote for other rooms.

English

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BOSE\_SUB-0000386. See also, BOSE\_SUB-0000361-448.

904. Then, as also mentioned before, the Bose Link communication protocol allows for



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an indication that additional rooms, for example, have been added to the media center. The Bose Link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the zones. The zones then respond by sending information back to the media center to let it know that the zone is still active. Importantly, as described below, the media center will not acknowledge commands from any zone that is not targeted or invoked (BOSE\_SUB-0000596).

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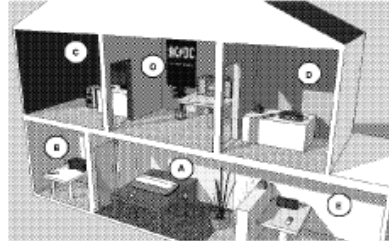
### What is Bose Link?

Bose link is a communication protocol. To communicate there must be at least two participants that speak the same language. To Bose products, Bose link is that language.

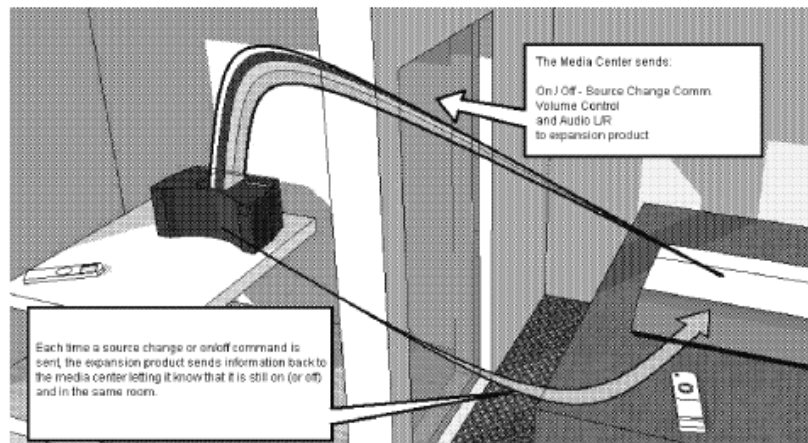
### Rooms

There are 15 different rooms that can be controlled by a Bose link enabled media center. The main room – labeled room A – is reserved for the Lifestyle speaker components. The other rooms – rooms B-O – are reserved for expansion via Bose link.

For a Bose link setup to work the system must include a Bose link enabled media center (a controller), a Bose link expansion product, and an expansion remote control. Both the expansion product and the remote must be configured to operate on the same room.



A Bose link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the expansion product. The expansion product responds by sending information back to the media center to let it know that it is still on (or off) and in the same room. This information exchange occurs each time a power or source change command is issued by the expansion remote.



When the media center receives an ON command from an expansion remote the system turns on and checks for any Bose link products that might be connected, but it will only look for Bose link products that are assigned to the same room as the remote.

Understanding Bose® link

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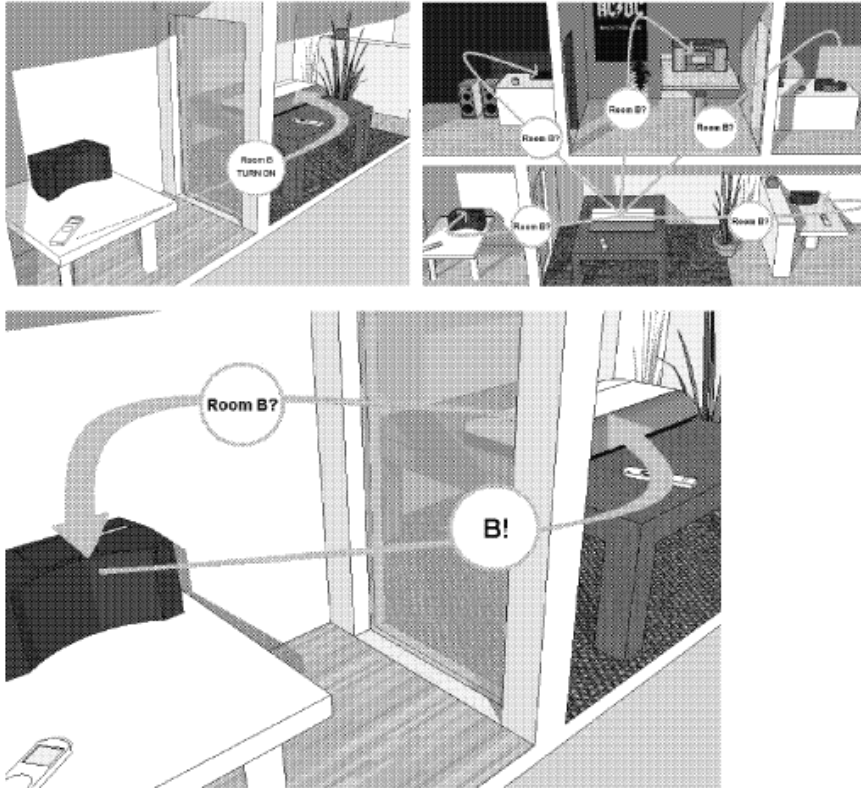
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If the media center receives a command from a remote configured for room B, for example, the media center calls out to other Bose link products which might be assigned to room B. If a connected expansion product is assigned to room B it will respond to the media center and a Bose link connection will be made. The media center will not acknowledge a response from anything not assigned to room B.



The media center will not acknowledge more than one response from the same room, either. As with any productive conversation, there can only be one person speaking at a time. If more than one product is assigned to room B the media center won't know which one to listen to. If the media center can't understand the response from the expansion products, or if there is no response at all, the media center will turn itself off and the Bose link connection will not be successful.

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I also incorporate by reference into this section, my rebuttals to Dr. Almeroth's opinions, as articulated above.

**42. Limitation 1.7: “(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player;”**

905. In my opinion, Bose Lifestyle discloses or renders obvious this claim limitation.

906. I incorporate by reference my discussion of Limitation 1.6 herein, which discloses receiving from a network device an indication that the zone player has been added to a zone scene comprising a predefined grouping of zone players that are to be configured for synchronous playback of media when the zone scene is invoked. Limitation 1.7 adds the limitation that the first zone player is a member of two different “zone scenes.”

907. In addition to the evidence disclosed in Limitation 1.7, the Bose Lifestyle expressly teaches managing two separate streaming sources at one time, such that room A can operate on stream 1, and room B can operate stream 2, for example.

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## Streams

A Bose link enabled media center is also capable of managing two separate sources at the same time. Each source can be sent to one of two different outputs - or 'streams' - within the Bose link connection. 4 of the 9 pins that make up the Bose link connection on the back of the media are responsible for delivering these streams - all of which are analog. Two pins are reserved for stream 1 audio L/R (fixed), and another two pins carry stream 2 audio L/R (fixed) - (there is another pair of pins that carry variable stream 2 audio that will be discussed later). Every Bose link expansion product has 2 inputs to accommodate each stream, and the remote control tells the device which stream to listen to. The expansion products receive fixed audio and then control volume via commands they receive from the media center carried on other pins.

### Here is an example:

If an expansion remote configured for stream 1 sends an ON command to the media center, the media center will activate the pins that carry stream 1 information. The media center will also call out to any Bose link product set to the same room code as the remote. If the media center gets an answer it can understand, it will respond by telling the expansion product to turn on and listen to its stream 1 inputs. If the media center does not get a response from an expansion product set to the same room as the remote it will simply turn itself off.

The main room, or room A, can only operate on stream 1. Although any of the expansion rooms can be configured to operate on either stream 1 or stream 2, expansion rooms are generally assigned to stream 2. Since only one source can be sent to each stream at any given time, keeping Bose link expansion products on stream 2 prevents changes made in expansion rooms from affecting what is being played in the main room, and vice-versa.

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**(b) Obviousness – POSITA**

908. In the alternative, this claim element discloses nothing more than overlapping speaker groups, which would have been obvious to a person of skill in the art at the time. Indeed, the Bose LifeStyle already disclosed having groups and dynamic reallocation of those groups, which indicates to a person of skill in the art that overlapping group membership is desirable, consistent with Sonos’s arguments in its summary judgment briefing. A POSITA would have been motivated to add overlapping groups because Bose LifeStyle’s own marketing materials touted the flexibility of its system to allow users to play back media throughout their household. *Supra*.

909. A person of skill in the art would have recognized that by allowing a user to create speaker groups, those groups may either (1) allow overlapping group membership or (2) not allow overlapping group membership. Given that allowing overlapping group membership may be attractive to certain users because there was a recognized “need for dynamic control of the audio players as a group,” it would have been obvious to select allowing overlapping group membership when implementing speaker groups. ’885 Patent at 1:30-34.

**(c) Obviousness – Nourse**

910. A person of skill in the art would also have been motivated to combine the Bose LifeStyle with Nourse, which discloses a plurality of speakers, each of which has “a unique 16-bit address.” Nourse, 3:57-58. “Each of the speakers also can be assigned up to four group identifiers.” *Id.* at 3:58-59. The group identifier “allows specific speakers to be assigned to a group and receive the same signal.” *Id.* at 3:61-63. Thus, any speaker “can be assigned to more than one group.” *Id.* at 4:5. Nourse is analogous to the ’885 patent because it is in the same field of endeavor, “controlling or manipulating a plurality of multimedia players in a multi-zone system.” ’885 Patent, 1:30-34. For example, Nourse, like the ’885 patent, explains that it is directed to “a centralized speaker system that allows multiple speakers connected to a central amplifier speaker



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line to be monitored and controlled from a central location via a master/slave protocol.” Nourse at Abstract. Nourse is also reasonably pertinent to the problem to be solved by the ’885 patent, which is “dynamic control of the audio players as a group.” For example, Nourse explains that speakers may be “addressed individually or as part of a group” by “receiving unique content specific, respectively, to the individual remote speaker address and group address” (*id.* at 2:35-39) where the group address or identifier “allows specific speakers to be assigned to a group and receive the same signal” and play back audio as a group (*id.* at 3:61-63). Nourse teaches additional means for improving the user experience by allowing a user to add a playback device to multiple groups. Nourse at 3:57-4:5. It would have been desirable to allow a user to have a particular zone player join multiple groups (e.g., the kitchen and patio could be grouped for outside entertainment, and the kitchen and living room could be grouped for inside entertainment). Having a speaker join multiple groups would increase the number of customized combinations a user could configure in their home, as the Bose LifeStyle recognizes as an important feature. Nourse is also analogous to the Bose LifeStyle system as both relate to digital speaker systems with dynamic grouping features.

**(d) Obviousness – Rajapakse (US 8,239,559)**

911. A person of skill in the art would have found it obvious to combine Rajapakse with Bose LifeStyle. Rajapakse was cited by many Sonos patents regarding speaker grouping, including patents from the same family as the ’885 Patent, indicating that persons of skill in the art recognized that Rajapakse was highly relevant to the claimed features. For example, Mr. Lambourne in prosecuting US 2013/0251174 disclosed Rajapakse as relevant prior art. 2014-04-17 Information Disclosure Statement. Rajapakse was also cited by the following patents—which are closely related to the ’885 patent.

US20130251174A1	Sonos, Inc.	Controlling and manipulating groupings in a multi-zone media system
US8788080B1	Sonos, Inc.	Multi-channel pairing in a media system

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US9226087B2	Sonos, Inc.	Audio output balancing during synchronized playback
US9226073B2	Sonos, Inc.	Audio output balancing during synchronized playback
US9456279B1	Google Inc.	Automatic control and grouping of media playback devices based on user detection
US9671997B2	Sonos, Inc.	Zone grouping
US9729115B2	Sonos, Inc.	Intelligently increasing the sound level of player
US10209948B2	Sonos, Inc.	Device grouping
US10306364B2	Sonos, Inc.	Audio processing adjustments for playback devices based on determined characteristics of audio content
US10331399B2	Apple Inc.	Smart audio playback when connecting to an audio output system
US10356526B2	Razer (Asia-Pacific) Pte. Ltd.	Computers, methods for controlling a computer, and computer-readable media
US10516718B2	Google LLC	Platform for multiple device payout
US11265652B2	Sonos, Inc.	Playback device pairing

912. Rajapakse discloses this claim element.

913. For example, Rajapakse discloses dynamic playback among many speakers in groups. 13:41-45 (“There may be multiple streams of audio being sent to multiple media renderers 203 in multiple zones at the same time. . . As an example, a media renderer may be the front left channel when a movie is being played to a screen that is centered between it and the front right. This would be configured as default movie stream. This same media renderer may be configured also to be the back left channel when playing a default HiFi audio stream, where hi performance front media renderers are positioned elsewhere in the room.”).

914. Rajapakse also discloses synchronized playback in speaker groups. 11:60-65 (“The rendition of each stream by a media renderer 203 (speaker) needs to be synchronized in time. This is enabled by the distribution server 204 working with the media renderer 203, using a stream protocol specific to the media renderers 203. This protocol includes the methods to time-synchronize rendition of the stream.”).

915. Rajapakse discloses dynamic grouping and transitioning speakers among different groups. 3:65-67 (“If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to

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transition to this new set of destination devices 103 automatically and without interruption.”).

916. Rajapakse discloses that each player/speaker may be a part of multiple groups. 4:47-54 (“Each media renderer 203 is set up with a variety of properties including lists of acceptable zone identifications, acceptable zone manager identifications, acceptable zone 50 control point identifications, lists of acceptable stream identifications, rendition properties such as volume and role properties.”).

917. Rajapakse discloses having many properties for players within a speaker group and therefore discloses “zone scenes.” 4:53-67 (“One of these properties, the 'role' of a media renderer 203, can define what stream channel the media renderer 203 will 55 play back. Each audio data stream may include multiple channels, where each channel is defined as front left, center, front right, back left, back center, back right, subwoofer, etc. The media renderer 203 can be configured to accept one of the channels in the stream. If the stream does not contain the channel the media renderer 203 is configured for, it may be configured to play an alternate channel or not play anything. In addition to the channel type roles, a media renderer's role may include other 'roles.' A media renderer's role could be to play only deep base sounds, or to play only high pitch sounds in the media. As another example, a media renderer's role may be to provide special effects, such as echoes or background sounds. As a further example, a media renderer's role may be to play pre-recorded media segments at various points of the media stream. For example, a media renderer 203 may play pre-recorded media segments on initiation by a control point or zone manager, or based on sensing various states or conditions, such as powering up the media renderer, or detecting a sensor condition.”).

918. Rajapakse discloses overlapping groups or zones, and therefore overlapping speakers within those zones. 5:61-67 (“A zone is a physical space that a number of media renderers belong to and within which the media renderers are physically located. Typically a zone is a

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listening space, a space where the audio from all the media renderers in the space can be heard. For example, all media renderers within a single auditorium will be in the same zone. Zones may overlap and may include other zones.”).

919. Rajapakse discloses that speakers may be a member of more than one group. 6:1-4 (“Each media renderer 203 is assigned to one or more zones. Zones are typically identified with a Zone Identifier (ZID).”).

920. Rajapakse discloses dynamic zone and speaker management. 6:6-19 (“The zone manager 210 dynamically gathers and aggregates information on the media renderers 203 in its vicinity and makes this information available to other services. . . . In addition to gathering media renderer information, the zone manager 210 holds information specific to a zone, manages the media renderers 203 in the zone, and may provide additional services and actions, such as media renderer reservation to other services such as control points 201. . . . The zone control point 209 is an enhanced version of a standard control point 201. The enhancements allow the zone control point 209 to interact with the zone manager 210 to quickly gather information on sets of media renderers 203 in a zone and perform actions on the zone.”).

921. Rajapakse discloses zone management that is dynamic. 12:51-59 (“Once a zone manager 210 registers a media renderer 203, the zone manager 210 may view and modify the media renderer's setup by interacting with a user directly or via a control point 201. This includes modifying the media renderer's zone list, default stream list, role, and properties such as volume.”).

**(e) Obviousness – Millington**

922. A person of skill in the art would have been motivated to combine Millington with the Bose LifeStyle because Mr. Millington worked on Sonos products that are in the same field of endeavor as the Bose LifeStyle, and therefore it would have been an obvious choice to look to for guidance about potential modifications to that system. Mr. Millington’s patents also described

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aspects of the Sonos System or aspects related to how those systems practice group synchronization and therefore a POSITA would have looked to Millington to understand the Sonos System or its competitors, like Bose LifeStyle. Millington was also assigned to Sonos and was filed in the same timeframe as the Sonos System was released.

923. Millington discloses this claim element.

924. Millington discloses standalone speakers and synchronous groups. Millington at 6 (“In the following, the term "synchrony group" will be used to refer to a set of one or more zone players that are to play the same audio program synchronously. Thus, in the above example, zone players 11(1) and 11(2) comprise one synchrony group, zone player 11(3) comprises a second synchrony group, zone players 11(4) and 11(5) comprise a third synchrony group, and zone player 11(6) comprises yet a fourth synchrony group. Thus, while zone players 11(1) and 11(2) are playing the same audio program, they will play the audio program synchronously.”); *Id.* (“Similarly, while zone players 11(4) and 11(5) are playing the same audio program, they will play the audio program synchronously.”).

925. Millington discloses using dynamic groups. Millington at 7 (“In the network audio system 10, the synchrony groups are not fixed. Users can enable them to be established and modified dynamically. Continuing with the above example, a user may enable the zone player 11(1) to begin providing playback of the audio program provided thereto by audio information source 14(1)(1), and subsequently enable zone player 11(2) to join the synchrony group. Similarly, a user may enable the zone player 11(5) to begin providing playback of the audio program provided thereto by audio information source 14(5)(2), and subsequently enable zone player 11(4) to join that synchrony group. In addition, a user may enable a zone player to leave a synchrony group and possibly join another synchrony group. For example, a user may enable the zone player 11(2) to leave the synchrony group with zone player 11(1), and join the synchrony group with zone player

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11(6). As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.”); Millington at 41 (“The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.”).

926. Millington discloses overlapping speaker groups. Millington at 17 (“As noted above, there may be multiple synchrony groups in the network audio system 10, and further that, for example, a zone player 11(n) may operate both as a master device 21 or a slave device 22(g) in one synchrony group, and as the audio information channel device 23 providing audio and playback timing information and clock timing information for another synchrony group.”); Millington at 19 (“Indeed, it will be appreciated that the zone player that is utilized as the audio information channel device for synchrony group 20(2) may also be a zone player that is utilized as the master device 21(1) or a slave device 22(1)(1),..., 22(K)(1) in the synchrony group 20(1).”).

927. I also incorporate by reference into this section, my rebuttals to Dr. Almeroth’s opinions, as articulated above.

(ii) *Limitation 1.8: “after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation;”*

928. In my opinion, Bose Lifestyle discloses this claim limitation, and I incorporate my analysis from the previous claim limitations.

929. For example, Bose LifeStyle discloses adding additional zones or rooms to the media center, and then programming each room to be a certain frequency. Put another way, Bose LifeStyle allows a user to add additional speakers to zones of the Bose media center, and if any



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the system architectures, a POSITA would have been dissuaded from modifying the Bose Lifestyle 50 System to combine it with the identified functionality of Rajapakse since adding Rajapakse's "zone" would have required adding these additional components to the Bose Lifestyle 50 System. In fact, such a modification would have altered the principle of operation of the Bose Lifestyle 50 System." For the reasons I stated above, Bose and Rajapakse are in the same field of endeavor. Regardless, Dr. Almeroth fails to explain how any modification to Bose would have "altered the principle operation of Bose." Nor does Dr. Almeroth explain why the additional of any elements from Rajapakse would have significantly altered the system architecture of Bose.

953. Further, Dr. Almeroth also asserts that "a POSITA would have been dissuaded from modifying the Bose Lifestyle 50 System to combine it with the identified functionality of Rajapakse because, to the extent it was even possible, adding Rajapakse's "zone" functionality would have required wholesale changes to the Bose Lifestyle 50 System in order to enable the Personal music center and/or multi-room interface of the Bose Lifestyle 50 System to communicate with the additional components from Rajapakse that are required to facilitate Rajapakse's "zone" functionality." But Dr. Almeroth fails to explain why or show how Bose's communication protocol is incompatible with Rajapakse, or even that any purported design changes would be significant.

(ii) *Limitation 1.9: "after the given one of the first and second zone scenes has been selected for invocation, receiving, from the network device over the data network, an instruction to operate in accordance with a given one of the first and second zone scenes respectively comprising a given one of the first and second predefined groupings of zone players; and"*

954. In my opinion, Bose Lifestyle discloses this claim limitation.

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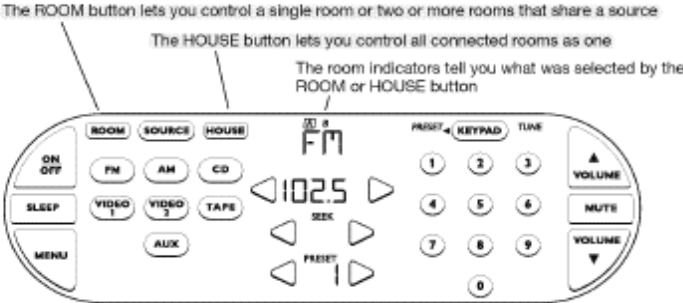
955. As described in the previous claim elements, and shown briefly below, a user may select a synchronization group for playback using the Room button, and use the playback controls to cause Bose LifeStyle to operate as a synchronous playback group.

**Operating a Multi-Room Lifestyle® 50 System**

**Operating in more than one room**

Your Lifestyle® 50 system can control up to four sets of Bose® powered speakers, allowing your family to enjoy different audio sources (CD, radio, TV, etc.) in up to four rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal™ music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 48 shows an example display for a two-room system.

**Figure 48**  
Example display for a two-room system




**Understanding the room indicators**


- ☒ A boxed letter indicates the presently-selected room or rooms. The selected room is affected by any source changes, or any change you make using the VOLUME, MUTE, ON/OFF, or SLEEP buttons.
- ☐ An unboxed letter indicates a room listening to a **shared source**. A shared source is one that is playing in the controlled room as well as in up to three additional rooms. If you change the radio station, CD track, etc., of the shared source, the change affects all rooms sharing this source. However, you cannot change sources for all affected rooms at the same time. The VOLUME, MUTE, ON/OFF, and SLEEP buttons only affect the boxed room(s).
- ☐ An empty box appears for each connected room when you press the HOUSE button. When you change the volume in the HOUSE mode, the numerical level appearing on the display does not represent the actual volume level in all connected rooms. It only represents the actual volume in rooms represented by a boxed letter.

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956. Further, Bose Link is used as protocol to communicate between and amongst the various zones in order to invoke, for example, the play command that simultaneously plays audio in multiple zones. More specifically, Bose Link in conjunction with the media center operates over a network and allows for a user's pre-defined zones to also play different audio in simultaneously.



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### What is Bose Link?

Bose link is a communication protocol. To communicate there must be at least two participants that speak the same language. To Bose products, Bose link is that language.

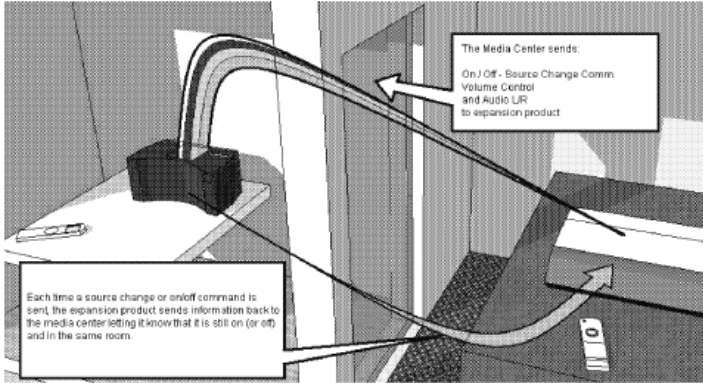
### Rooms

There are 15 different rooms that can be controlled by a Bose link enabled media center. The main room – labeled room A – is reserved for the Lifestyle speaker components. The other rooms – rooms B-O – are reserved for expansion via Bose link.



For a Bose link setup to work the system must include a Bose link enabled media center (a controller), a Bose link expansion product, and an expansion remote control. Both the expansion product and the remote must be configured to operate on the same room.

A Bose link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the expansion product. The expansion product responds by sending information back to the media center to let it know that it is still on (or off) and in the same room. This information exchange occurs each time a power or source change command is issued by the expansion remote.



When the media center receives an ON command from an expansion remote the system turns on and checks for any Bose link products that might be connected, but it will only look for Bose link products that are assigned to the same room as the remote.

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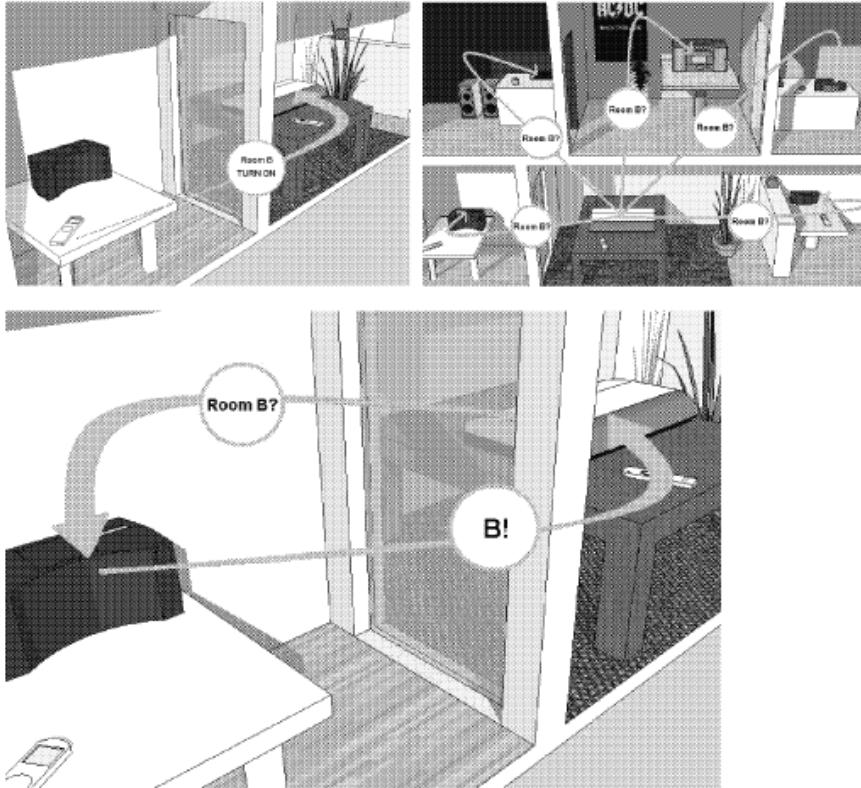
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If the media center receives a command from a remote configured for room B, for example, the media center calls out to other Bose link products which might be assigned to room B. If a connected expansion product is assigned to room B it will respond to the media center and a Bose link connection will be made. The media center will not acknowledge a response from anything not assigned to room B.



The media center will not acknowledge more than one response from the same room, either. As with any productive conversation, there can only be one person speaking at a time. If more than one product is assigned to room B the media center won't know which one to listen to. If the media center can't understand the response from the expansion products, or if there is no response at all, the media center will turn itself off and the Bose link connection will not be successful.

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## Streams

A Bose link enabled media center is also capable of managing two separate sources at the same time. Each source can be sent to one of two different outputs - or 'streams' - within the Bose link connection. 4 of the 9 pins that make up the Bose link connection on the back of the media are responsible for delivering these streams - all of which are analog. Two pins are reserved for stream 1 audio L/R (fixed), and another two pins carry stream 2 audio L/R (fixed) - (there is another pair of pins that carry variable stream 2 audio that will be discussed later). Every Bose link expansion product has 2 inputs to accommodate each stream, and the remote control tells the device which stream to listen to. The expansion products receive fixed audio and then control volume via commands they receive from the media center carried on other pins.

### Here is an example:

If an expansion remote configured for stream 1 sends an ON command to the media center, the media center will activate the pins that carry stream 1 information. The media center will also call out to any Bose link product set to the same room code as the remote. If the media center gets an answer it can understand, it will respond by telling the expansion product to turn on and listen to its stream 1 inputs. If the media center does not get a response from an expansion product set to the same room as the remote it will simply turn itself off.

The main room, or room A, can only operate on stream 1. Although any of the expansion rooms can be configured to operate on either stream 1 or stream 2, expansion rooms are generally assigned to stream 2. Since only one source can be sent to each stream at any given time, keeping Bose link expansion products on stream 2 prevents changes made in expansion rooms from affecting what is being played in the main room, and vice-versa.

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957. I also incorporate by reference into this section, my rebuttals to Dr.



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Almeroth's opinions, as articulated above. Dr. Almeroth contends that "seen no evidence that the Personal Music Center transmits any sort of information in response to a user selecting one or more rooms using the Room or House button of the Personal Music Center." I disagree. As shown above, the Bose link is essentially a conversation between the media center and the playback speakers such that the media center sends commands along with audio to the playback speak, which then "responds" with information. BOSE\_SUB-0000595.

958. Dr. Almeroth also states that "I disagree that a POSITA would consider an instruction to play audio in response to a user "us[ing] the playback controls" to be "instruction operate in accordance with" a group of Lifestyle players having a "shared source" of audio for the additional reason that such an instruction would not provide a Lifestyle player with any indication whatsoever that it was to operate as part of a group of Lifestyle players having a "shared source." This is consistent with the other evidence I have reviewed showing that a Lifestyle player would have never had any awareness that it was part of a group of Lifestyle players having a "shared source" because the multi-room interface was exclusively responsible for the "shared source" functionality." But as stated above, Dr. Almeroth does provide any analysis, just provides conclusory statements, and does not cite any "evidence" that he reviewed.

959. Next, Dr. Almeroth also asserts that "the materials cited by Dr. Schonfeld do not teach 'an instruction to operate in accordance with' any given group, let alone 'a given one of the first and second zone scenes.'"



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(iii) *Limitation 1.10: “based on the instruction, transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players such that the first zone player is configured to coordinate with at least one other zone player in the given one of the first and second predefined groupings of zone players over a data network in order to output media in synchrony with output of media by the at least one other zone player in the given one of the first and second predefined groupings of zone players.”*

960. In my opinion, Bose LifeStyle discloses this claim limitation.

961. As described in the previous claim elements, a user may select a synchronization group for playback using the Player selector box, and use the playback controls to cause Bose LifeStyle to operate as a synchronous playback group.

962. I also incorporate by reference into this section, my rebuttals to Dr. Almeroth’s opinions, as articulated above.

## **XII. INVALIDITY OF ‘966 PATENT BASED ON ANTICIPATION AND OBVIOUSNESS**

### **A. ‘966 Claims Are Obvious Based On Prior Art Sonos Products (“Sonos System”)**

963. The Sonos System was publicly available, on sale, offered for sale, and described in printed publications both before the critical date (*i.e.*, prior to September 12, 2005), before the alleged conception date (*i.e.*, prior to December 21, 2005), and prior to the patent filing date on September 12, 2006. The features offered in that system were substantially the same during each of those time frames, as discussed below.

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964. The capabilities and features of the Sonos System are apparent from source code that Sonos has made available for inspection, the products themselves, technical documentation that Sonos has made available, public documentation regarding that system, professional and customer reviews, and other sources discussed below.

965. In my opinion, Claim 1 is rendered obvious based on the Sonos System in view of the general knowledge of a POSITA, the Sonos Forums, Nourse, and Millington, as described below. Below, I analyze each limitation of Claim 1 and demonstrate why that claim is invalid.

## **2. Claim 1 Is Obvious Based On Prior Art Sonos Products (“Sonos System”)**

(i) *Limitation 1 (Preamble): “1. A computing device comprising:”*

966. *See supra* ‘885 claim 1 “network device” disclosure in, e.g., 1.6, 1.7, 1.9.

(ii) *Limitation 1.1 “one or more processors;”*

967. *See supra* ‘885 claim 1 “network device” disclosure in, e.g., 1.6, 1.7, 1.9. Limitation 1.2 “a non-transitory computer-readable medium; and”

968. *See supra* ‘885 claim 1 “network device” disclosure in, e.g., 1.6, 1.7, 1.9.

(iii) *Limitation 1.3 “program instructions stored on the non-transitory computer-readable medium that, when executed by the one or more processors, cause the computing device to perform functions comprising:”*

969. *See supra* ‘885 claim 1 “network device” disclosure in, e.g., 1.6, 1.7, 1.9.

(iv) *Limitation 1.4 “while serving as a controller for a networked media playback system comprising a first zone player and at least two other zone players, wherein the first zone player is operating in a standalone mode in which the first zone player is configured to play back media individually:”*

970. *See supra* ‘885 claim 1 “network device” disclosure in, e.g., 1.6, 1.7, 1.9, “network interface” disclosure in, e.g., 1.1, “zone player” disclosure in, e.g., preamble, 1.1, 1.4-1.7, .9-10, “standalone mode” disclosure in, e.g., 1.5, 1.8, 1.10.

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- (v) *Limitation 1.5 receiving a first request to create a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked;*

971. *See supra* ‘885 claim 1 Limitation 1.6. Included in my incorporation by reference is my discussion of the “first zone scene” disclosure in, e.g., 1.6 I include in my incorporation by reference the discussion of the creation of the first zone scene, its composition, its synchronous playback configuration, and the ability of invocation of that zone scene.

972. Additionally, dependent claim 6 of the ‘966 patent informs the scope of independent claim 1. Dependent claim 6 of the ‘966 patent recites that “wherein the first predefined grouping of zone players does not include the third zone player, and wherein the second predefined grouping of zone players does not include the second zone player,” effectively requiring that the first and second predefined groupings of zone players not be entirely overlapping, each with the same three zone players. Because claim 6 depends from claim 1 and must necessarily narrow the scope of claim 1, I understand that claim 1 includes first and second predefined groupings of zone players, where those groupings of zone players can wholly overlap. Indeed, such an overlap scenario would be consistent e.g., with a user having a user-created zone group including all three zone players, and having a “Party Mode,” *i.e.*, a zone group including all three zone players. I therefore incorporate by reference the disclosure of “party mode” from my discussion, *supra*, regarding claim 1 of the ‘885 patent. I note that the claim scope of claim 7 of the ‘885 patent includes a similar limitation and therefore implies a similar scope for claim 1 of the ‘885 patent. This is supportive of my opinions regarding claim of the ‘885 patent as well.

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- (vi) *Limitation 1.6 based on the first request, i) causing creation of the first zone scene, ii) causing an indication of the first zone scene to be transmitted to the first zone player, and iii) causing storage of the first zone scene;*

973. *See supra* ‘885 claim 1, Limitation 1.6.

- (vii) *Limitation 1.7 receiving a second request to create a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the third zone player is different than the second zone player;*

974. *See supra* ‘885 claim 1, Limitation 1.6, 1.7.

- (viii) *Limitation 1.8 based on the second request, i) causing creation of the second zone scene, ii) causing an indication of the second zone scene to be transmitted to the first zone player, and iii) causing storage of the second zone scene;*

975. *See supra* ‘885 claim 1, Limitation 1.6, 1.7.

- (ix) *Limitation 1.9 displaying a representation of the first zone scene and a representation of the second zone scene; and*

976. *See supra* ‘885 claim 1, Limitations 1.6 and 1.7.

- (x) *Limitation 1.10 while displaying the representation of the first zone scene and the representation of the second zone scene, receiving a third request to invoke the first zone scene; and*

977. *See supra* ‘885 claim 1, Limitation 1.9.

- (xi) *Limitation 1.11 based on the third request, causing the first zone player to transition from operating in the standalone mode to operating in accordance with the first predefined grouping of zone players such that the first zone player is configured to coordinate with at least the second zone player to output media in synchrony with output of media by at least the second zone player.*

978. *See supra* ‘885 claim 1, Limitation 1.10.

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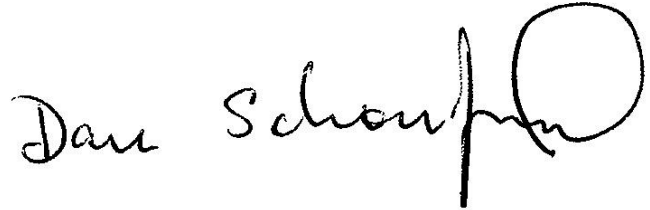
**3. Claim 2 Is Obvious Based On Prior Art Sonos System.**

- (i) *Limitation 2.1 The computing device of claim 1, further comprising program instructions stored on the non-transitory computer-readable medium that, when executed by the one or more processors, cause the computing device to perform functions comprising:*
- (ii) *Limitation 2.2 while the first zone player is configured to coordinate with at least the second zone player to playback media in synchrony with at least the second zone player, receiving a fourth request to invoke the second zone scene; and*
- (iii) *Limitation 2.3 based on the fourth request, causing the first zone player to (a) cease to operate in accordance with the first predefined grouping of zone players such that the first zone player is no longer configured to coordinate with at least the second zone player to output media in synchrony with output of media by at least the second zone player and (b) begin to operate in accordance with the second predefined grouping of zone players such that the first zone player is configured to coordinate with at least the third zone player to output media in synchrony with output of media by at least the third zone player.*

979. See '966 claim 1 *supra*. As discussed above, the Sonos system and the identified obviousness combinations disclosed the system in claim 1. Those disclosures included the ability to receive a third request to “invoke” the first zone scene. For the same reasons, that system also discloses the ability to “invoke” a different (second) zone scene. Even if the Sonos system did not disclose or render obvious this requirement, the mere addition of one additional transition in a system that already permits this same transition for different “zone scenes,” as described *supra*, would have been obvious, as it is merely repeating the same steps using the same functionalities with a different “zone scene.”

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I, Dan Schonfeld, declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

A handwritten signature in black ink that reads "Dan Schonfeld". The signature is written in a cursive style, with the first name "Dan" and last name "Schonfeld" clearly legible. The signature ends with a large, circular flourish.

DATED: November 30, 2022

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Dan Schonfeld, Ph.D